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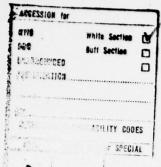




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A SYSTEMS ANALYSIS OF WATER QUALITY SURVEY DESIGN

Documentation of the Survey Planning Computer Program. A User's Manual

Authors: Dr. L. C. Wilcox, Dr. B. E. Gilliland, Dr. R. W. Gilchrist, Dr. T. M. Keinath

August 1975

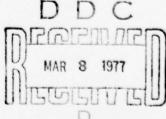
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Water Quality Survey Design	nolity Managements			
Army Ammunition Plants water Q	adirey neadurements			
This is the final report of a three year proj	ect titled, "A Systems Analysis			
of Water Quality Survey Design."				
In this project a study was made of water qua				
United States Army Environmental Hygiene Agency (A				
from studies of Army Ammunition Plants (AAP) were				
The focus of this project was the development				
which would assure efficient use of manpower and e				
measurements taken give a reasonalbe representation	n of the system. Planning the			

survey, conducting the survey and reporting on the survey were included in the study.

The site modeling program models the manufacturing processes which contribute pollutants to the system, models the sewer system, and models the treatment system including acid or caustic neutralization, settling ponds, and domestic treatment. The inputs to the model are the production levels of the manufacturing processes and the outputs are the predicted pollutant measurement values at each possible measure point in the system.

The resource matching program accepts data defining proposed measurements and matches these against the available time, manpower, and equipment. The output lists the pollutant to be measured at each measure point, the total commitment of time for each analyst and for each piece of equipment. Note is made of any overcommitment of manpower or equipment.

The model refinement or updating program accepts measurements taken during a preliminary survey or during a regular survey and computes suggested new parameters for the process models.

The indicator model program evaluates the performance of sanitary treatment facilities.

The program uses design data, data from the operating log and/or data generated during the survey and computes key operational characteristics. Comparing these with desirable values as cited in design books and manuals will give the survey planner insight into the operation of the system and suggest the need for more survey measurements or the need for changes in operation.

A system was developed for automatic instrumentation of pH, conductivity, and other parameters which use strip charp recordings. Interface hardware was selected and purchased and interface software was developed for direct connection to a digital computer.

A data handling system was developed for use during and after the survey. A PDP8-OS/8 and peripheral equipment was purchased. Software was developed to perform data handling functions and to direct the user in application of the software. The program accepts raw data from the analytical chemist and performs data conversions, transcriptions, and data logging functions. Output is available in several forms as may be needed for various reports during and at the end of the survey.

Recommendations are the survey planner should obtain sufficient data in a proliminary survey to model and analyze the site; measurements should be automated to the maximum extent possible; data handling should be delegated to the computer when the operations are well defined and repetitive. The programs, software and hardware included here will assist the survey planner in following these recommendations and design a more effective survey.

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INTRODUCTION

This manual was written to assist in the use of the Survey Planning Program developed as part of the research entitled "A Systems Analysis of Water Quality Survey Design" conducted by the Engineering College at Clemson University and supported by U.S. Army Medical Research and Development Command.

The program can perform three basic functions by assembling the proper subroutines. These functions are:

- Modeling and simulation of the plant site operation. The model includes the effluent of the manufacturing processes, the sewer system pollutants, and industrial and domestic sewers treatment.
- 2. Resource matching or resource commitment for a planned survey.

 Using the modeling and simulation results, the survey planner determines the frequency and location of the measure points for each pollutant to be measured. The RM model uses this information along with information on available resources (time, personnel and equipment) determines the required commitment of personnel and equipment. Note is made of non-feasible survey plans which would require more personnel or equipment than is available. The survey planner can then add more personnel or equipment for the survey or try another survey plan which will use different personnel and equipment. By iterating through several survey plans the planner can find a survey plan which will yield the maximum of useful data for the available time, personnel and equipment.

3. Model Verification and/or Updating.

The site model process models can be updated or improved using preliminary survey data or survey results. While the best data available were used in constructing the process models, there was considerable variation in data for a given process from one plant to another or from one season to another. Better process model values may be obtained using the CORRCT subroutine with judiciously selected grab samples, taken on a preliminary survey. Survey results can also be used to verify or refine the process models. With confidence in the model, it can now be used to predict levels of potential pollutants for production levels other than those which occurred during the survey. This should give added significance to the survey report.

The site modeling and simulation uses MAIN and the following subroutines: PROCES, START, TOP, NEUTRA, SETTLE, DOME.

The resource matching application uses all of the subroutines required for site modeling plus the following subroutines: LEVEL, FLAG, RM, CONCK, TO, EQCHER, VSCHEC, CNCHEC, ADD, SET, PIEQCH, SUBT, INFORM, SAMPLE, PRPAR, USECT, TICHAN.

The model verification and/or updating uses all of the subrouintes required for site modeling plus the subroutine CORRCT.

The functions of the subroutines are discussed briefly below.

MAIN: sets the system dimensions and calls appropriate subroutines.

PROCES: This program reads in process mnemonics for processes present at the particular site being studied. Appropriate process data is called out of process library. Process data can be altered to better represent a particular site.

Process Library: Contains process models.

START: Reads in; the number of processes (sources), the number of branches, the number of parameters and the number of outfalls in this site study. Also reads in the numbers of the particular pollutants in the current study (NPLIST). Reads in branch names. Branches are named for convenient interpretation of output data. Calls CHK1. CHK1: Reads in the number of non-competing parameters (used in RM); reads in the names of all of the pollutants in the master list, for each the number of measurement methods available and the sampling frequency. This program also prints out the input information available at this point. In particular this includes the process data and the topology matrix.

TOP: This program essentially does the following: reads in treatment data; takes process data and site topology data and calculates the flow and pollutant parameters for each branch of the system. The effects of treatments are included in the calculation; calls the treatment subroutine NEUTRA, SETTLE, and DOME; calls CHK2 to output results.

NEUTRA: This subroutine is called by TOP if acid or caustic neutralization is required in any branch.

SETTLE: This subroutine is called by TOP is a settling pond or clarifier is required in any branch.

DOME: This subroutine is called by TOP if domestic or sanitary treatment is required.

CHK2: This program essentially writes out the results of the TOP calculations, i.e., the system simulation.

FLAG: This subroutine is not used in system simulation but in system . planning with RM. However, it is called by TOP to prepare data for RM.

LEVEL arranges TOP output for use in RM.

FLAG allows survey planner to specify for RM, measure points in addition to those selected by RM logic.

RM reads in and prints out resource information, allocates resources and calls subroutines when needed to relieve violations, and prints out resource allocation information.

CONCK determines feasible measure methods and allocates resources to flagged points.

TO zeros out temporary allocations for equipment times.

EQCHEC determines if any equipment time violations occur.

VSCHEC checks for van space constraint violations.

CNCHEC checks for analyst time constraint violation.

ADD adds current allocations of equipment time, analysts' times, van space and costs.

SET stores the array of methods used at a branch in a level for a given parameter.

PIEQCH searches past assignments to attempt to relieve constraint violations.

SUBT subtracts current allocations.

INFORM prints out branch names and parameters to be measured at that branch.

SAMPLE allocates analyst type I time required for taking samples and measuring flow.

PRPAR outputs parameter measurement information.

USECT total usage equipment.

TICHAN converts minutes to hours and minutes.

CORRCT is used for model verification or updating.

Subsequent sections of this manual define the data required by these program subroutines, list the required coding and ordering of data, and illustrate the format and computer card layout required by the subroutine. Also, the various components of the output information are listed and explained in the last section of this manual.

The programs have been written so that only the subroutines required for the particular application need to be read in. Thus, the program could be visualized as three separate decks with some of the subroutines appearing in more than one deck. Also, the complete set of subroutines can be read as one big single program. Depending on the computer facilities available, memory space available and turn-around time may be a problem if the three smaller decks are not used.

In either case flags have to be read in MAIN to define the particular application that is desired.

NFLAG = 0 call LEVEL and RM

= 1 terminate after TOP or CORRCT

EPSLON = 0 do not call CORRCT

= 1 call CORRCT

These are read in with the following statements in MAIN

READ (1,900) NFLAG

READ (1,800) EPSLON

900 FORMAT (1 5)

BRIEF DESCRIPTION OF FORMAT STATEMENTS

The purpose of the FORTRAN FORMAT statements is to tell the computer what kind of information is to be inputted and where to find that information on a data card. In this program, only three different types of data are inputted: integer data ("T" FORMAT), floating point data ("F" FORMAT) and alphanumeric data ("A" FORMAT).

Integer Data

Integer formats are of the form wIm, where w is the number of integer data fields, and m is the length of each integer field. For example, 3I5 will read 3 items of data from a card, with each item in a field 5 card columns wide. It should be mentioned that within a field the data must be right justified. This means that if a I4 format is used to read in the number 6, 6 must appear in the 4th column of the field. If it does not, the trailing blanks are read as zeros. So, if the 6 is placed in the 3rd column, it will be read by the computer as 60, or in the 2nd column it will be read as 600. Care must be taken that integers are right justified. Many apparent programming errors may be caused by incorrect punching of data cards.

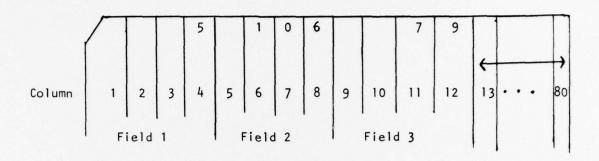
Examples:

READ 100, K, L, M

100 FORMAT (314)

This will read in three integer values for the variables K, L, and M.

If the desired values for those variables are 5, 106 and 79, the data card would appear as follows:



Since the computer will only look at the first 12 columns in this example, columns 13-80 could be filled with anything.

Floating Point Data

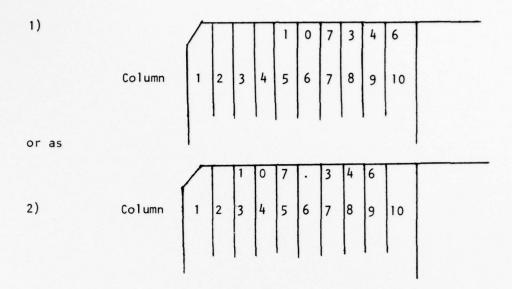
Floating Point Formats are of the Form wFm.n, where w is the number of floating point fields, m is the total width of each field, and n is the number of places to the right of the decimal point. The restriction on n is $n \le m+1$, since one place is reserved for the decimal point. Floating point allows the user to omit the decimal point, if the data if right justified. Otherwise, data may be placed anywhere in the Field.

Example:

READ 101, X

101 FORMAT (F10.3)

If the value desired for X is 107.346, the data card may appear as:



The presence of the decimal point overrides the Format specification. In the first case, if 107346 started in column 4 instead of column 5 it would be read in as 1073.460.

Alphanumeric Data

Alphanumeric formats are of the Form wAn, where w is the number of alphanumeric fields, and n is the width of each field. Any character may be read in as alphanumeric data.

Example:

READ 102, NAME, N, J

102 FORMAT (2A4,A3)

	1	1	Т	L	E	S			3	2	7
Column	1	2	3	4	5	6	7	8	9	10	11
	1		d 1			Fie	•			Fiel	

In this example, variable NAME would have the computer representation of 'TITL' stored in it, N would contain 'ES &b' (& represents a blank) and J would contain the alphanumeric representation of '327'. It is important to note that this "value" of J does not correspond to an integer value of 327.

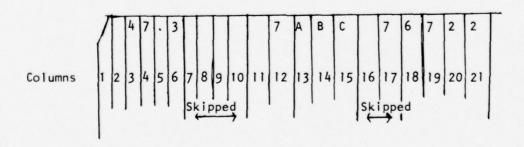
Mixed Formats

In many instances integer, floating point, and alphanumeric data all appear on the same card. It is simply a matter of combining the different formats in the correct sequence to read this data. Also, many times certain columns of the data card will want to be skipped. To accomplish this, the nX Format is used where n is the number of columns to be skipped.

Example:

READ 103, X, I, N, Y

103 FORMAT (F6.2, 4X, I2, A3, 2X, F4.1)



The value of X will be 47.3, the value of I will be 7, the "value" of N will be ABC, and the value of Y will be 672.2. Notice that the 7

which appears in column 17 is not assigned to any variable since it is in a column which is skipped.

For each item of data that is needed by the program, the associated READ statement and FORMAT statement is included, along with a sample data card in the "User's Manual."

MAIN PROGRAM USERS GUIDE

1. Required Main Data and Format

The only data required by MAIN are MASTER, MFLAG, and EPSLON.

If NFLAG is "1" the program stops after the TOP or CORRCT subroutine calculations are complete. The TOP subroutine calculates the flow, mass, and pollutant parameter for each branch of the system. If NFLAG is "0" the program goes from TOP into the RM subroutine where the survey is planned.

MASTER is the largest parameter number to be used in the current study. The master list of parameters is given in Table II. If in a given study no parameter listed above total phosphates is to be included then MASTER is 18.

If EPSLON = 0 the CORRCT subroutine is not called. For EPSLON = 1 the CORRCT subroutine is called.

MASTER and NFLAG are read in with the following statements:

READ (1,900) MASTER

READ (1,900) NFLAG

READ (1,900) EPSLON

900 FORMAT (15)

The following card layout is for MASTER=18

The following car layout is for NFLAG= 1 or for EPSLON = 1

II. Changing System Planning Program Dimensions

The program and subroutines have been written so that only cards in the MAIN program need to be changed to redimension the system. The quantities that can be varied are: the number of pollutant parameters, the number of sources (processes), the number of branches, the number of pieces of equipment.

The specific items in the MAIN program which must be changed to redimension the system are given in the following paragraphs:

To handle more than 25 sources (where i = number of sources) in the MAIN program,

change MSORS = 25 to MSORS = i and in the Dimension statement the arrays to modify are:

XNAME (25)		XNAME (i)
YNAME (25)		YNAME (i)
FLOW (25)		FLOW (i)
SPLIST (25,25)	CHANGE	SPLIST (i,25)
CAP (25)		CAP (i)
A (25,25)		A (i,25)
c (25,25)	ТО	C (i,25)
P (25,25)		P (1,25)
SUM (25)		SUM (i)
SUMA (25)		SUMA (i)

To handle more than 25 branches (where n = number of branches) in the program,

change MBRNC = 25 to MBRNC = n and in the DIMENSION statement the arrays to modify are:

A (25,25)		A (25,n)
Y (25,25)		Y (n,25)
X (25,25)		X (n,25)
EFF (25)		EFF (n,25)
NBRNCH (25,2)		NBRNCH (n,2)
IBN (51,25)		IBN (51,n+1)
PC (25,25,25)	CHANGE	PC (25,25,n)
AMAR (25,27)		AMAR (25, n+2)
NALOW (25,25)	TO	NALOW (25,n)
BRN (25)		BRN (n)
BRANCH (25,25)		BRANCH (n,25)
NROUR (25)		NROUT (n)
NFLOW (25)		NFLOW (n)

To handle more than 25 parameters (m = number of parameters), in the MAIN program,

change MPARM = 25 to MPARM = m

and in the DIMENSION statement the arrays to modify are:

SPLIST (25,25)		SPLIST (25,m)
C (25,25)		C (25,m)
Y (25,25)		Y (25,m)
X (25,25)		X (25,m)
P (25,25)		P (25,m)
NPLIST (25)		NPLIST (m)
POLN (25,5)		POLN (m,5)
NTEMP (25)		NTEMP (m)
SAMFRE (25)	CHANGE	SAMFRE (m)
NMA (25)	CHANGE	NMA (m)
MENAME (25,3,5)		MENAME (m,3,5)
PCRM (25,3)	то	PCRM (m,3)
PURM (25,3)	10	
PMDATA (25,3,4,5)		PMDATA (m,3,4,5)
100 (25,25)		1DO (m, 25)
PM (25,25,25)		PM (m, 25, 3)
AMAR (25,27)		AMAR (m,27)
PC (25,25,25)		PC (m,25,25)
NALOW (25,25)		NALOW (m,25)
EQUSED (25,75)		EQUSED (m,75)
NSET (25,3)		NSET (m,3)
FLGPT (25)		FLGPT (m)
RANK (25)		RANK (m)
BRANCH (25,25)		BRANCH (25,m)
ELE (25)		ELE (m)

To handle more than 75 pieces of equipment (j = number of equipment) in the MAIN program,

change MEQ = 75 to MEQ = j

and in the DIMENSION statement:

change VNSP (75) to VNSP (j)

 SMEQTI (75)
 SMEQTI (j)

 EQUSED (25,75)
 CHANGE
 EQUSED (25,j)

 EU (75)
 EU (j)

 EQTIME (75)
 TO
 EQTIME (j)

 EQNAME (75,5)
 EQNAME (j,5)

It should be noted that these are the only changes required on the array dimensions. There is no need to make modifications in the subroutines. Also, it is <u>very important</u> that the array parameters MSORS, MBRNC, MPARM, MEQ MBRP1, and MP2 and the array subscripts correspond exactly. For example, if MPARM = 31, then every array that is affected by an increase in parameter capability must have "31" appearing in the proper subscript position as explained in that section. Care should also be exercised that <u>every</u> array has its proper subscript changed. Any omission may lead to errors that may not be immediately apparent.

PROCESS MODEL USER'S GUIDE

I. PROCESS MODEL INTRODUCTION

The process model is used to define a manufacturing plant in terms of the pollutants produced by the manufacturing processes as a function of the production levels of the various plant components. In order that the model be applicable to more than one plant, manufacturing operations are subdivided on the basis of "objectives" and then further subdivided into "processes" required by these objective. "Objectives" are identified in terms of general plant products or objectives. A given plant may have one or several "objectives". Examples are: continuous TNT; TNT (batch); paint stripping of artillery shells. The processes are manufacturing operations which are definable in terms of production level and resultant pollutants. The processes are operations which may be components of one or several "objectives" and may occur in one or several plants. Models are constructed for each process which may occur in any of the plants to be surveyed. A plant process model is obtained by assembling the appropriate process models. The input to this model is the production level of each of the processes making up the plant model. The output is an ordered listing of the types and levels of pollutants generated by producing products at a certain level. Also listed are the points in the effluent drain system at which the pollutants enter. Any time variation in pollutant flow requires a new listing, a listing for each state.

The pollution potential of an effluent is measured in a number of ways. One type of measurement is to determine the concentration of a particular element or compound. An example of this type of measurement would be the measure of sulfates in milligrams per liter. Another type of measurement measures a characteristic of the system not necessarily

STNT

```
SUBROUTINE STNT (FLOW, SPLIST, CAP, JM, MSORS, MPARM)
DIMENSION FLOW (MSORS), SPLIST (MSORS, MPARM), CAP (MSORS)
0001
0002
0003
           FLOW (JM) = 0.01 * CAP (JM) * 0.10
0004
           SPLIST (JM,1) = 1.5
0005
           SPLIST (JM,3) = 40000
           SPLIST (JM,4) = 40
0006
           SPLIST (JM,7) = 1000
0007
           SPLIST (JM,8) = 8
8000
0009
           SPLIST (JM,9) = 20000
           SPLIST (JM, 10) = 10
0010
0011
           SPLIST (JM, 12) = 2500
0012
           SPLIST (JM, 15) = 1500
0013
           SPLIST (JM, 16) = 5.0
0014
           SPLIST (JM, 18) = 0.5
           SPLIST (JM, 19) = 10.0
0015
           SPLIST (JM, 20) = 20
SPLIST (JM, 22) = 0.0
0016
0017
           SPLIST (JM,23) = 5.0
SPLIST (JM,24) = 5000
0018
0019
0020
           RETURN
0021
           END
```

EXAMPLE PROCESS

Figure I

related to only one chemical element or compound. Examples of this type of measurement are conductivity, color, and pH. To speak of in general of the numbers that define the level of pollution potential, whether they are of one or the other of the above types, the term "pollution parameter" will be used.

Figure I is an example of a computer program subroutine model of a process. Statement 0001 gives subroutine name. Statement 0002 is the DIMENSION statement. Statement 0003 computes the effluent flow from this process in million gallons per day (MGD) for a given operating level, CAP (JM) in % capacity for JM. The remaining lines 0004 through 0019 give the pollutant parameters necessary to define this process. These parameters must be identified by a number assigned in a master list given in Table II. For example, SPLIST (JM,3) = 40000 gives the conductivity of the effluent of the process numbered JM. Three is the parameter number for conductivity from the master list.

Further, each process is identified by a mnemonic from a master list.

A list is given in Table I.

Finally, the process modeling is complete for a given plant when all of the processes and their operating levels are identified for that plant and the computer program calls in the appropriate subroutines which defines these processes. This information includes a listing of the points in the drain system at which the pollutants enter.

II. GENERAL DESCRIPTION OF PROCESS MODEL PROGRAM

The process model is identified by a mnemonic name for a specific operation within a plant and is defined in terms of production level capacity and the parameters which measure the pollutants found in the effluent of that operation. A master list of process models is available in Table I. These models are contained in the main program card deck.

During the preliminary survey all processes which make up the plant operation are identified in terms of the proper mnemonic from the master list. The expected operating capacity in % of full load is noted for each process. The mnemonic and capacity are placed on a data card for read in by the PROCES subroutine. These process cards are read in the order determined by the topological numbering discussed on page 39 under ordering of data and coding. There are no restrictions on the numbering or ordering of the processes except that once the numbering has been assigned it must be used here and in the topology part of the program.

As the subroutine PROCES reads in the process data cards it forms a plant model in terms of a SPLIST matrix. The SPLIST matrix has as its rows the different processes present and as its columns the parameter values, the parameters in order as defined by the master list of Table II and processes in the order read in. An abbreviated SPLIST matrix format example for the first five process models as well as the first four pollutant parameters is described for BAAP.

ORDER IN WHICH FOUND IN PROGRAM AND MNEMONICS	CORRESPONDING SUBROUTINES
PAPC - AOP Compression	SAPC
PAOP - AOP - Flow 3	SAOP
PSAC - Sulfuric Acid Concentrator	SSAC
PNAC - Nitric Acid Concentrator	SNAC
PBDN - Blowdown at BAAP	SBDN
PBIX - Ion Exchange at BAAP	SBIX
PCOW - Cooling Water - Flow 10	SCOW
PNBP - Nitration and Boiling Operations	SNBP
PBPP - Beater and Poaching Operation	SBPP
PBEX - Benzene Extraction	SBEX
PNCS - Nitrocellulose into Ball Power	SNCS
PNGS - Ball Power with Nitroglycerin	SNGS
PPND - Pond at Head of Sewer	SPND
PAPP - AOP - Flow 4	SAPP
PSWG - Sewer Influent - Flow into STP Process	SSWG
PCWZ - AAP - Cooling Water - Flow 11	SCWZ
PPAS - Purification Acid Scrubber	SPAS
PPCU - Purification Clean-Up	SPCU
PPCW - Purification Cooling Water	SPCW
PFSW - Finishing Scrubber Water	SFSW

PROCESSES

(SOURCES)

TABLE 1

Table 1 Continued:

ORDER IN WHICH FOUND IN PROGRAM AND MNEMONICS	CORRESPONDING SUBROUTINES
PFCU - Finishing Clean-Up	SFCU
PFCW - Finishing Cooling Water	SFCW
PTCW - Tank Car Wash	STCW
PSAR - Sulfuric Acid Recovery Cooling Water	SSAR
PSAW - Sulfuric Acid Recovery Waste Acid	SSAW
PANP - Acid Neutralization Plant (Radford)	SANP
PCIX - Ion Exchange at Newport - C line	SCIX
PZBM - Ion Exchange at Newport - A line	SZBM
PCWB - Power House Cooling Water at Newport	SCWB
PAPN - AOP at Newport	SAPN
PNDN - NAC/DN at Newport	SNDN
PGRB - Grab Sample at M-6 at Newport	SGRB
PSAZ - Sulfuric Acid Recovery at Newport	SSAZ
PTNT - TNT Lab at Newport	STNT
PPHZ - Pumphouse #2 at Newport	SPHZ
PSTP - Sewage Treatment Plant Influent at Newport	SSTP

PROCESSES

(SOURCES)

TABLE 1

Table 1 Continued

PCWL	-	Cooling Water Blowdown	SCWL
PODW	-	Oil/Descalar Water	SODW
PCOA	-	Cutter Oil - Line A	SCOA
РСОВ	-	Cutter Oil - Line B	SCOB
PRWS	-	Rinse Water Supply	SRWS
PAPS	-	Alkaline Paint Stripper	SAPS
PADR	-	Alkaline De-Rust	SADR
PZPP	-	Zinc Phosphate Dip - Paint Stripping	SZPP
PCAP	-	Chromic Acid Rinse - Paint Stripping	SCAP
PAPK	-	Alkaline Pre-Cleaner	SAPK
PAHC	-	Alkaline Hot Cleaner	SAHC
PZPD	-	Zinc Phosphate Dip - Detrex	SZPD
PCAD	-	Chromic Acid Rinse - Detrex	SCAD

PROCESSES

TABLE 1

- 1. pH
- 2. COD
- 3. CONDUCTIVITY
- 4. TOC
- 5. AMMONIA $(NH_3) N$
- 6. DISSOLVED SOLIDS
- 7. NITRITE/NITRATE (N)
- 8. TOTAL N (KJELDAHL)
- 9. TOTAL SOLIDS
- 10. SUSPENDED SOLIDS
- 11. TOTAL HARDNESS
- 12. SULFATES
- 13. MBAS .
- 14. SULFITES
- 15. CHLORIDES
- 16. VOL. SUSP. SOLIDS
- 17. SODIUM
- 18. TOTAL PHOSPHATES
- 19. TNT
- 20. CALCIUM
- 21. COLOR
- 22. ALKALINITY
- 23. TURBIDITY
- 24. ACIDITY

25. BOD MASTER LIST OF PARAMETERS

TABLE II

	РН	COD	CONDUCTIVITY	ТОС	← Pollutant Names in Columns
PPND	6.0	20.0	0.0	11.0	
PAPC	6.2	20.0	0.0	11.0	← Pollutant
PAOP	6.2	20.0	0.0	11.0	Parameters
PAPP	6.2	20.0	0.0	11.0	
PNAC	2.5	25.0	0.0	22.0	

Process Model names in rows

ABBREVIATED SPLIST MATRIX

TABLE III

The PROCES subroutine is written such that if a process mnemonic and capacity is read in on a data card and there is no library subroutine defining this process, a row will be reserved in SPLIST with parameter data to be supplied later.

The PROCES subroutine also accepts data which will alter one or more parameter for any process present. If the user feels that at a

particular plant site a different parameter value gives a better model, the parameter can be changed. Further in a more extreme case, all new parameters can be read in for a given process if existing data and the judgment of the user warrant the change. Clearly, this latter capability can be used to include a process in a survey planning when the process is not in the process library.

111. GENERAL DESCRIPTION OF PROCESS MODELS

Flow rates in MGD are based on the production capacity of the process model at the time it was evaluated. A summary of each process model as of July 1, 1974, is enclosed by location, code name, flow rate, capacity at 100%, capacity at evaluation, and other characteristics to clarify the process description as deemed necessary.

BAAP Badger

- PAPC (.57 MGD) 6 units at 50 T/D. Total 300 T/D. Evaluated at 75 T/D. 3-8-5. AOP Compression
- PAOP (.48 MGD) Same as PAPC (Cooling water)
- PSAC (1.6 MGD) 3 units at 150 T/D each. 3-8-5. Evaluated at 110 T/D (Cooling water) Sulfuric Acid Concentrator
- PNAC (.30 MGD) 16 towers at 30 T/D each. 3-8-5. Evaluated at 50 T/D (Cooling water) Nitric Acid Concentrator
- PBDN (.08 MGD) 4 boilers at 175,000 lb stream/hr each.

 Continuous at 5 per cent of production. Blow down
- PBIX (.01 MGD) 7 columns at 150,000 lb stream/hr each. Evaluated at 4 columns. 400 GPM for 10 min. backwash. 132 GPM for 15 min. slow rinse. 264 GPM for 50 min. fast rinse. Once every 30 hours. Ion Exchange
- PCOW (.30 MGD) Cooling water from boiler at 25 percent capacity. Continuous. 1.5x stream production. Cooling Water
- PNBP (.50 MGD) 17,000 lb/day. 8 am 3 pm weekdays. Nitration and Boiling
- PBPP (.20 MGD) 120,000 lb/day. Evaluated at 11,000 lb/day from E-line. Continuous. Beater and Poaching
- PBEX (.45 MGD) 610,000 lb/mo. of reprocessed nitrocellulose.
 Intermittent. Benzene Extraction
- PNCS (2.0 MGD) 2,700,000 lb/mo. of ball powder. Evaluated at 700,000 lb/mo. 3-8-5 Nitrocellulose into Ball Powder
- PNGS (.09 MGD) Same as PNCS.
- PPND (.40 MGD) Pond overflow based on the water treatment level.

 45 MGD. Evaluated at 12 MGD. Continuous. Pond
- PAPP (.89 MGD) Same as PAPC (Process water).

- PSWG (.27 MGD) Based on BAAP facilities. Continuous. Sanitary Sewer
- PCWZ (.20 MGD) Cooling water from compressors, fans, and pumps. 50 Percent of capacity on weekdays and 25 percent on weekends. Continuous.
- NOTE: All values for BAAP are based on averages in the assay or data sheets. Additional element values were added to the assay values for cooling water and process water effluents by using the data sheets for raw water and process water.
- RAAP (The ten processes for one 50 T/D continuous TNT line). (Radford)
- PPAS (.0015 MGD) Purification Acid Scrubber
- PPCU (.02 MGD) Purification Clean Up
- PPCW (.90 MGD) Purification Cooling Water
- PFSW (.0024 MGD) Finishing Scrubber Water
- PFCU (.01 MGD) Finishing Clean Up
- PFCW (.15 MGD) Finishing Cooling Water
- PTCW (.015 MGD) Tank Car wash
- PSAR (1.5 MGD) Sulfuric Acid Recovery Cooling Water
- PSAW (.01 MGD) Sulfuric Acid Recovery Waste Acid
- PANP (.135 MGD) unique to RAAP. Acid Neutralization Plant
- NAAP Newport
- PCIX (.3214 MGD) 3 cation exchanges with 2 operations during evaluation. 6,000 gal. tank for bulk storage.

 Evaluated at 90 percent capacity. Ion exchange Newport-A
- PZBM (.0381 MGD) 2 anion exchanges with 1 operating during evaluation. Evaluated at 90 percent capacity. Ion exchange Newport-C
- PCWB (.17 MGD) 120 GPM normal blowdown. Evaluated at
 90 percent capacity. Power House Cooling Water Newport
- PAPN (.30 MGD) 350 T/D of 65 percent HN03. 100 percent acid basis. AOP at Newport
- PNDN (.30 MGD) 2 NAC units with 100 T/D capacity of 98.5 percent acid. 4 denitiating units with 290 T/D of TNT waste acid each. Nitric Acid Concentrator-Newport

PGRB (.002 MGD) - Unique to NAAP Grap Sample at M-6 Newport

PSAZ (.30 MGD) - Regeneration of 7.4 T/D of 40 percent Oleum and 326 T/D of 20 percent Oleum. Sulfuric Acid Recovery-Newport

PTNT (.10 MGD) - 5 lines at 50 T/D each. Evaluated at one line with outfall unique to NAAP. TNT Lab-Newport

PPHZ (.02 MGD) - Evaluated at 90 percent capacity. Pumphouse #2-Newport

PSTP (.50 MGD) - Based on NAAP facilities. Sewage Treatment Plant Influent-Newport

NOTE: Values were based on conference at Clemson University in January 1974. All operations are continuous and 100 percent capacity was used unless noted otherwise.

LAD Letterkenney

Shell Production - 160,000/mo. Evaluated at 100,000/mo.

PCWL (.0286 MGD) - Sample Point J Cooling Water Blowdown

PODW (.154 MGD) - Sample Point K Oil/Descaler Water

PCOA (.01 MGD) - G-12 (10,000 gal. cap. tank) Cutter Oil Line A

PCOB (.01 MGD) - G-13 (10,000 gai. cap. tank) Cutter 0il Line B

Paint Stripping - 3 to 5 percent of the shells are rejected.

Capacity is 500-700 shells/day/shift. There are 2 lines of which 1 line was used during evaluation not at fall capacity. Continuous overflow for rinse is 2 GPM.

PRWS (.0056 MGD) Rinse Water Supply

PAPS (.00035 MGD) Alkaline Paint Stripper

PADR (.00035 MGD) Alkaline Derust

PZPP (.00035 MGD) Zinc Phosphate Dip

PCAP (.00035 MGD) Chromic Acid Dip

Point Preparation - "DEXTREX" process of batch dumps which last 10 minutes at the end of each work period. Continuous overflow for precleaner and hot cleaner 4 GPM.

PAPK (.001 MGD Weekly) Alkaline Pre-Cleaner

PAHC (.0012 MGD Monthly) Alkaline Hot Cleaner

PZPD (.0011 MGD Monthly) Zinc Phosphate Dip- Detrex

PCAD (.0009 MGD Daily) Chromic Acid Dip-Detrex

Notes: Averages of days 2, 6, and 9 were used for point "J". Averages for days 8-13 were used for point "K".

IV. REQUIRED PROCESS SUBROUTINE DATA INPUT AND FORMAT

The following paragraphs describe the data required by the PROCES subroutine and the card format required by the subroutine.

The cards and data will be discussed in the order in which they must be read in. The data required is:

- 1. The number of processes in the plant model, N
- The process names, XNAME (JM), and the percent of full production capacity, CAP (JM)*
- A flag indicating whether or not there are to be pollutant parameter modification for any of the processes, NOD
- 4. If there are modifications, give the number of parameters to be changed, NMOD
- For each parameter to be changed, give the process name, the pollutant number, and the new pollutant value. YNAME (NM), ELE (NM), VAL (NM) - One card for each parameter to be changed.
- A flag indicating whether or not there are to be any complete processes changed, NPRO (Could be a new process)
- If there are processes to be changed, give the number of processes to be changed, NUMP
- 8. Read in the number of parameters currently in the master list, NELE.
- For the first process to be changed, read in the process name and the % of full capacity flow. ZNAME (JN), FLW (JN)
- One card for each parameter in the master list in the same order as in the master list, giving the new parameter values, SPLIST (JE, JK)
- 11. Repeat 9 and 10 for each process to be modified.

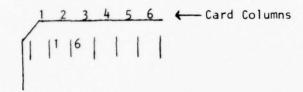
^{*}Must be readin in the same order as topological numbering.

The data card formats are read in statements for the PROCESS data and are now given.

1. The number of processes in the plant model N. Example for 16 processes:

READ (1, 10)N

10 FORMAT (1X, I2)



200 FORMAT (1X, A4, 1X, F6.2)

One card for each process giving process mnemonic and the %
 of full production capacity. Example: PTNT at 500% capacity.
 READ (1,200) XNAME (JM), CAP (JM)

3. Flag to indicate pollutant parameter modifications. If there are modifications NOD=1. If there are no modifications NOD=0.

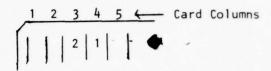
Example: NOD=1

READ (1,400) NOD 400 FORMAT (1X, II)



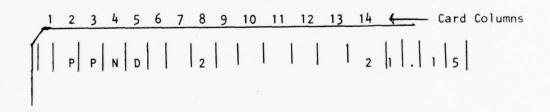
4. If there are modifications the next card gives the number of parameters to be modified. Example: 21 (bypassed if NOD=0)
READ (1,700) NMOD

700 FORMAT (1X, I3)



5. In this group, one card for each parameter to be changed. Give the process mnemonic, the pollutant number and the pollutant parameter value. Example: PPND, pollutant number 2, pollutant parameter value 21.15 (number 2 is COD)

READ (1,750) YNAME (NM), ELE (NM), VAL (NM)
750 FORMAT (1X, A4, 1X, I2, 1X, F9.2)



 This is a flag card to indicate if any complete processes are to be changed. If there are modifications NPRO=1. If there are no modifications NPRO=0. Example: NPRO=1

READ (1,875) NPRO

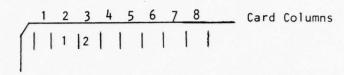
875 FORMAT (1X, I1)

7. If there are complete processes to be modified, this card gives the number of processes to be changed. Example: 12

(bypassed if NPR0=0)

READ (1,890) NUMP

890 FORMAT (1X, I2)

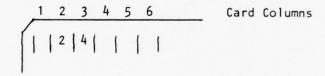


8. Next read in the number of parameters currently in the master list.

NELE Example:24

READ (1,890) NELE

890 FORMAT (1X, I2)

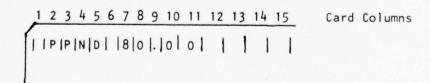


For the first process to be changed, read in the process mnemonic and the % full load capacity.

Example:
$$ZNAME (JN) = PPND, FLW (JN) = 80$$

READ (1,895) ZNAME (JN), FLW (JN)

895 FORMAT (1X, A4, 1X, F6.4)



10. This next group of cards (NELE in number), one for each parameter in the master list, gives the value for each parameter defining the process. These must be in the same order as in the master list of parameters.

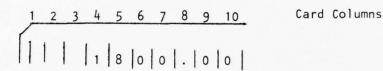
Example card: the third card - conductivity = 1800.

DO 897 JK=1, NELE

READ (1,898) SPLIST (JE,JK)

898 FORMAT (1X, F9.2)

897 CONTINUE



11. Cards described in 7 through 10 are bypassed if NPRO = 0. Procedures described in 9 and 10 are repeated for each process to be modified. Clearly this procedure can be used to include processes in a survey plan when these processes are not included in the process library. However, this use does not place the new process in the library. The next section explains how a new process may be added to the library.

- V. Procedure for Adding a Process Model to the Library:
 - A. Add a DATA statement to the existing set of data statements to initialize the new process name.

DATA P 1 2 3/4HP 1 2 3/

B. Add an IF statement to the existing set of IF statements to allow the main program to call the new process

IF (XNAME (JM). EQ. P $\underline{1}$ $\underline{2}$ $\underline{3}$ CALL S $\underline{1}$ $\underline{2}$ $\underline{3}$

New Subroutine
Process Name for
Name 4 Subroutine
Characters that Defines
the New Process

Positions 1 2 3 being the same.

C. Add a subroutine with the following form to define the new process.

SUBROUTINE S 1 2 3 (FLOW, SPLIST, CAP, JM, MSORS, MPARM)

DIMENSION FLOW (MSORS), SPLIST (MSORS, MPARM), CAP (MSORS)

FLOW (JM) = 0.01 \pm CAP(JM) \pm {Some value to represent the flow of the process at 100% capacity}

SPLIST (JM,1) = {value of first element in process}

SPLIST (JM,2) = {value of second element in process}

These are values of pollutant I through N

SPLIST (JM,N) = {value of Nth element in process}

RETURN The SPLIST array must be redimensioned END if N > 25.

If a pollutant's value is not known or is zero, then the statement defining that pollutant may be omitted and the program will insert a zero into the SPLIST array for that pollutant.

VI. Summary:

The user must be aware of the most recent master lists of process models and pollutant names contained in the system library so that he can plan his overall data gathering requirements during the preliminary survey. He must not feel that each new operation is unique, requiring the development of data for the addition of new process models.

As more process models are added to the library, the emphasis in preliminary surveys can be placed on the determination of the flow rate at full production, the production operating capacity during measurement periods; and a few measurements of operations similar to the process models in the library to verify previously recorded data. When there is a large deviation in a pollutant parameter the methods and procedures of the operation which contributed the unfavorable parameter should be investigated and compared to the favorable operation to possibly recommend improvement rather than merely record the unfavorable parameter as a modification. Confidence in the validity of the data will increase as the surveys improve in quality.

TOPOLOGY MODEL USER'S GUIDE

I. Collection of Data:

The topology data of a site consists of the following:

- 1. A map of the sewer lines (include flow direction).
- 2. Identification of all processes (sources) noting where these processes empty into the sewer system.
- 3. Identification of all treatment facilities and where these treatments occur in the sewer system.
- 4. Note the location of all manholes, weirs or other possible sample points in the sewer system.
- 5. Identification of pollutant parameters to be measured.
- 6. Settling pond areas if any-type of neutralization if any-type of domestic treatment if any

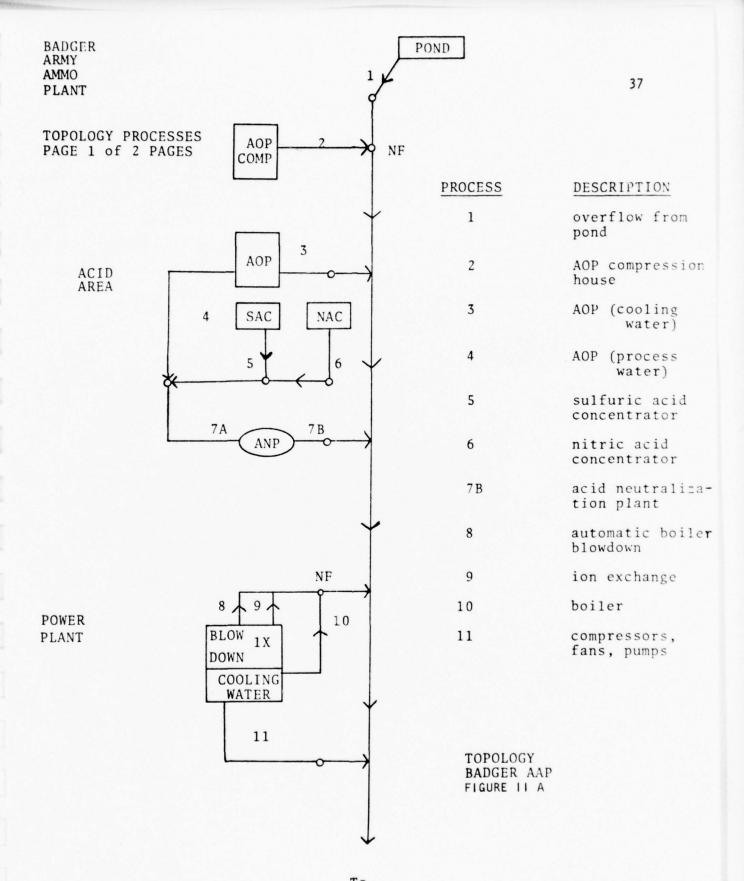
Figure II a and II b give the topology data for Badger AAP and serves as a good example of how to record the necessary data.

The sewers are represented as directed line segments showing the flow directions and interconnections.

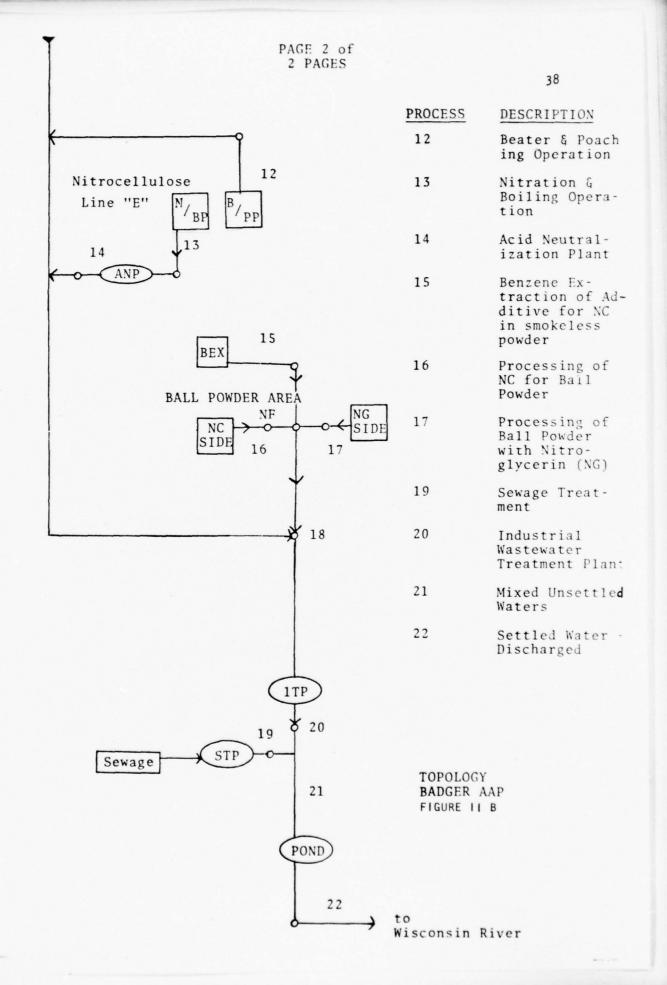
The processes are represented as rectangles and are identified by number and/or some meaningful acronym. The location of the point where each process discharges its effluent into the sewer is also known.

Treatment facilities are represented by ovals and are identified by an acronym describing the type of treatment. (Acid or caustic neutralization, settling, domestic sewage treatment.)

The location of all manholes, weirs, or other possible sample points are represented as circles on the sewer line. Further identifying and describing information can be included if necessary as shown by the collumn on the right side of Figures I a and I b.



To Nitrocellulose Area



II. Ordering of Data and Coding

All of the data must be ordered (numbered) and coded.

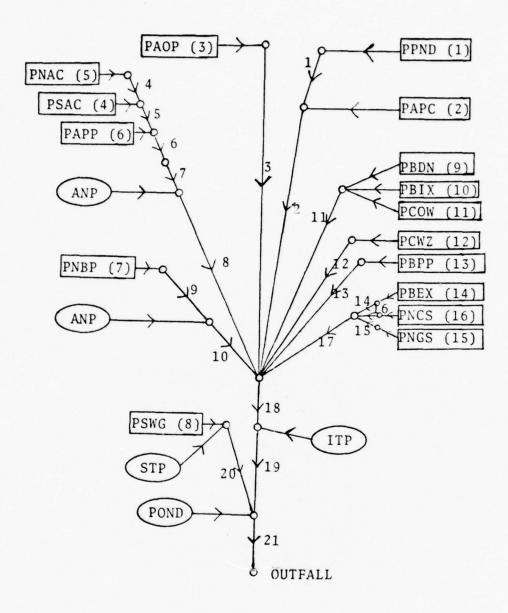
All processes (sources) must be identified on the master list for which subroutine exist in the porcess model. This master list is given in Table I. Each process is then assigned the proper mnemonic listed in the left column of Table I. This correct coding is necessary if the program is to call the correct subroutine (named in the right hand column) which defines that process. Note: In the section describing "Processes," it is explained how a process in the master list can be modified to fit the needs of the user.

After the processes have been assigned their appropriate mnemonic, the processes must be numbered. The numbering order is arbitrary but when assigned it must be used consistently throughout the program (In both "Process" and "Topology").

Next one needs to identify and order the measure points and identify the flows of all processes which pass through each measure point. This ordering and identifying is best done by using a linear graph as shown in Figure III for the Badger AAP system of Figure II a and II b.

The rules for constructing the linear graph are:

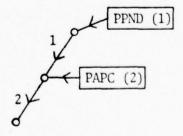
1. Each process is represented by a rectangle containing the process mnemonic code and a line from the rectangle to the point where the process discharges into the system.



Linear Graph for Badger AAP Sewer System Figure III

- Each manhole or other measure point is represented by a directed line segment on the graph.
- Each leg of the sewer system that does not contain a manhold or measure point is contracted to "zero" length.
- 4. The direction of flow in each line segment is indicated by an arrow head.
- Partial treatments are represented by ovals containing an identifying code and a line from the oval to the point in the system where the flow is treated.
- 6. The essential information on the linear graph includes the identity and ordering of all processes, identity and ordering of measure points, and flows from each process which pass through each possible measure point.

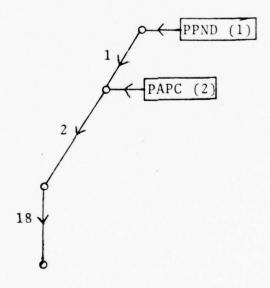
As a rule of thumb, one can begin the construction of the system linear graph by going to the "preliminary survey" data such as shown in Figures II a and II b and start by listing a process approximately the greatest number of measure points away from the outfall. In the example this is the "overflow from pond", its mnemonic is PPND. We shall assign this as process number one (1) and note that the flow enters the system at a manhole which we will identify as measure point number one (1) and represent as a directed line segment on our graph in Figure IV.



Beginning Construction of System Linear Graph (Step 1) Figure IV

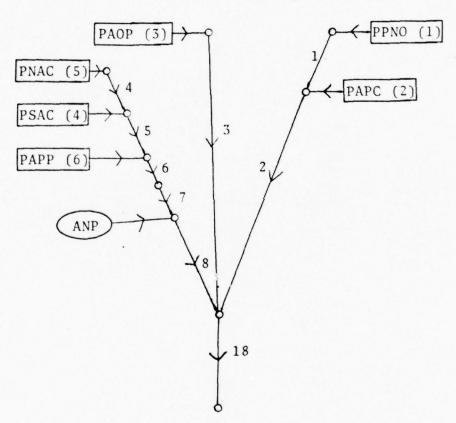
Next as we proceed from measure point number one to the next measure point to which we assign number two, note that flow from the process identified as "AOP Compression House" must be included at measure point two. The process is identified by its mnemonic, PAPC, and assigned the number two, (2). In Figure IV the flows from processes 1 and 2 are included at measure point number 2 represented by a directed line segment

Figures I a and I b show no manholes or other measure points in the sewer system from the point marked NF on Fig. II a to the point marked 18 on Fig. II b. Thus, all these sections of sewer line are contracted to a single point and the Figure V shows the linear graph including measure point 18.



Construction of System
Linear Graph
(Step 2)
Figure V

It is noted from Figures II a and II b that several other flows are included at measure point 18. In Figure VI several of these are added and Figure III shows the completed linear graph. Figure VI shows the addition of processes PAOP (3), PAPP (6), PSAC (4), and PNAC (5). Measure points 4, 5, 6, 7, and 8 are included. Acid neutralization treatment is included as ANP oval acting on flow entering measure point 8.

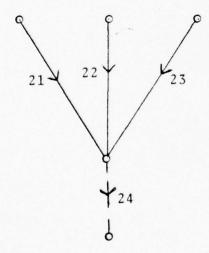


Construction of System Linear Graph (Step 3) Figure VI

There are restrictions in numbering the measure points (branches of the linear graph). The restrictions are:

- The numbering must start at 1 and continue consecutively to the highest number.
- The numbering must be such that in tracing from any branch j
 to the outfall only higher numbered branches will be encountered.
- 3. Thus, the outfall branch must have the highest number.

outfalls, the outfall elements of the separate parts are connected together and a fictitious new outfall element is included in the linear graph. In the input data a data item designated NTOP gives the program the information necessary to handle this situation. Figure VII illustrates the addition of the fictitious outfall.



21 - outfall of Part 1 22 - outfall of Part 2 23 - outfall of Part 3 24 - fictitious outfall.

Multiple Outfalls Figure VII

III. Construction of the Topology Matrix

A convenient way of tabulating the flow information for entering into the computer program is to put the information in a matrix form. The information required for each branch of the linear graph (each possible measure point) includes:

- 1. Does the flow of source i flow through branch j?
- 2. Does the flow undergo any treatment in branch j? If so, what treatment?

A matrix is constructed with a column, j, for each branch of the system and a row, i, for each source of the system. The entries for the ith row are obtained by starting at the ith process on the linear graph and tracing a path through the branches to the outfall. If the path does not include the jth branch the ij entry is zero. If the path does include the jth branch an appropriate number is entered in the ij position. That appropriate number depends upon whether or not the flow undergoes treatment in that branch and specifically which treatment. If the flow of source i passes through branch j and no treatment occurs at branch j, then the ij entry is 1. If the flow of source i passes through branch j and the composite flow in branch j is treated at branch j, then the ij entry is 2,3, or 4 depending on the type of treatment as follows:

acid or caustic neutralization -2
settling pond -3

domestic sewage treatemnt -4

Figure VIII gives the topology matrix for the system of Figure III.

IV. Identification of Pollutant Parameters

It is necessary to supply information to the programs which tell the particular pollutant parameters that are to be measured on a survey. Each of the processes are defined in terms of 25 parameters. However, all of these may not be measured in a given survey. These 25 parameters are listed and numbered in a master list given in Table II. These are in the same order used in the process model. The table numbers for specific parameters is supplied to the program on a data card. Also, another set of cards is used to read in the names of the parameters to be measured.

PROCESSES

BRANCHES

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 1 2

TOPOLOGY MATRIX

FIGURE VIII

V. Names of System Branches

The program was written to require names as well as numbers to be assigned to the branches. Up to an eight letter mnemonic is used here. Meaningful names assigned here will allow more rapid interpretation of print outs.

VI. Treatment Facilities Data

The TOP subroutine, in calculating the pollutant valves for each branch of the system, takes into consideration any treatment facilities in the system. Treatment types modeled include acid or caustic neutralization, settling pond (industrial), and domestic sewage treatment.

Data required to identify and define the types of treatment used follows.

- 1. Clarifier or settling pond area in acres (industrial treatment)
- 2. Acid or caustic neutralization (industrial treatment)

MNEUT
$$\begin{cases} 1 & \text{acid neutralization} \\ 2 & \text{caustic neutralization} \end{cases}$$

If MNEUT = 1 then for neutralizing agent

If MNEUT = 2

NCAUS
$$\begin{cases} 1 & \text{H}_2\text{SO}_4, \text{HCI or HNO}_3 \\ 2 & \text{CO}_2 \end{cases}$$

3. Domestic sewage treatment.

ITYPE = 0 trickling filter = 1 activated sludge

TRICKLING FILTER

AREAP primary clarifier area in acres

TVOL trickling filter volume in acre-feet

TEMP wastewater temperature (°C)

R2 recycle from filter effluent (MGD)

R3 recycle from secondary clarifier (MGD)

R4 recycle to filter (MGD)

TFAREA trickling filter area in acres

K20 = 0.23 for 1" rock media

= 0.13 for $2\frac{1}{2}$ rock media

AREAS secondary clarifier area in acres

ACTIVATED SLUDGE

AREAP as above

AREAS as above

ABVOL aeration basin volume in (MG)

MLSS mixed liquor suspended solids (Mg/1)

YN net yield from plant log data

Rl activated sludge recycle (MGD)

VII. Flagging

The flagging information required by the program is generally not data collected on the preliminary survey but rather is data based on the judgement of the survey officer. The judgement may be based on experience but will also be based on results of trial runs of the planning programs during the survey planning operation. If a flag is associated with a

particular pollutant at a particular point in the system, measurement will be made of that pollutant at that point and resources will be committed before assignments are made by the Resource Matching Model.

Three types of flagging procedures are available.

- 1. Automatic flagging.
- 2. Manual flagging of sources
- 3. Manual flagging of branches

For automatic flagging a subroutine is included which will check the total mass of any pollutant discharged at the outfall. The program will then automatically flag any source which contributes more than X (decimal fraction) to this total. The source is flagged for the measurement of this parameter only. The survey officer can specify the value of X for each parameter.

The subroutine also permits the survey officer to flag for measurement any particular source for any particular parameter or any particular branch for any particular parameter.

VIII. Required Topology Subroutine Data Input and Format

The input data required by the topology part of the survey planning program are:

- 1. The number of sources, NS
- 2. The number of branches, NB
- e. The number of pollutant parameters, NP
- 4. The number of outfalls, NTOP
- The number designation from Table II of the parameters to be measured on the survey, NPLIST (I)
- 6. The topology matrix data, A (J.I)
- 7. The branch names, NBRNCH (1,J)

- *8. The length of the survey in days (LENGTH)
- *9. The number of noncompeting parameters (ISTOP)
- 10. The parameter names POLN (N,I)
- *11. The number of measure methods for each parameter (NMA(N))
- *12. The sampling frequency per day (SAMFRE(N))
- 13. Sewage treatment data
- 14. The flagging levels FLGPT(1)
- 15. The source and parameter manual flags NF, NX(I), NY(I)
- 16. The branch and parameter manual flags NFB, NX(I), NY(I)

*These data are read in here by subroutine CHKI but are used in Resource Matching.

The data cards for these data are read in the order listed above immediately after the process model data cards. The card formats are described below: (this data is called for by topology subroutines.)

The NS, NB, NP, NTOP are read in on one card, the first card, with four fields each five long and right justified.

The number designations from Table II of the parameters to be measured are read in on one card, with 25 fields each three long and right justified. These are read in as NPLIST. The following card layout is for measurement of parameters: 1, 3, 5, 6 etc.

The topology matrix is read in next, one row of the matrix per card and the rows in the same order as in the topology matrix. The cards are read in with the following statements:

DO 2 J = 1, NS
READ (1,3)
$$(A(J,I), I = NB)$$

- 3 FORMAT ((80I1))
- 2 CONTINUE

As an example, the following card layout is for the first row of the topology matrix of Figure VIII:

The branch names are read in an order with the following statements:

DO 30
$$I = 1$$
, NB

30 READ (1, 901) (NBRANCH (I,J), J = 1,2) 901 FORMAT (2A4)

For example, branch #1 may be assigned the name POND1. The card format would be as shown below. One card is used for each branch. (up to 8 characters can be used)

The length of the survey design in days is read in at this point, by CHK 1 subroutine. The information is used in the resource matching subroutine. The sampling frequency and constraints are given on a per day basis. If survey periods different from a per day basis need to be considered in planning this entry allows such periods to be considered.

The number of days is read in with the following statements: READ (1, 903) LENGTH

903 FORMAT (12)

For a one day period the card layout is as follows:

The number of noncompeting parameters is read in at this point by CHK1. The information is used in the resource

matching subroutine. The program is written so that parameters which have only one measurement method available can be listed first. Available resources are assigned for these parameters first. If an ISTOP number is entered to designate the number of these parameters, then when the program is later searching for alternatives it will not search back through these. The designation is ISTOP and it is read in with the following statements:

READ (1,100) ISTOP

100 FORMAT (I2)

And for 2 noncompeting parameters the card layout follows:

The names of all parameters in the master list (Table II) must be listed in the same order. The program saves the names of those parameters previously designated to be included in this survey. One parameter is listed per card. On the same card, for each parameter the number of measure methods available (NMA (N)) and the sampling frequency (SAMFRE (N)) for that parameter are listed. The NMA(N) and the SAMFRE(N) are used in the resource matching subroutine but are read in here by subroutine CHKI while entering the parameter name. The significance of the NMA(N) is discussed in the resource matching section of the manual. The SAMFRE(N) is the

number of samples for day per measure point for the Nth parameter.

The data card layout is according to the format statement:

FORMAT (5A4, 5X, II, 4X, F6.1)

and for the parameter alkalinity, 2 measure methods, and 4 samples per day per measure point:

	1 2 3 4 5 6 7 8 9 10		20						25 26					30					36					
\langle	1A1L1K1A1L1I1N1I1T1Y1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	121	1	i	1	1	1	1	1	141.1
	POLN (N)														NN	MA (N))				SA	AMI	FRI	E(N)

The sewage treatment data is read in next. The reading format and the programs using the data are written so that all cards listed must be included. Appropriate data is included on the cards. When a particular treatment is not included, the cards normally carrying this data are left blank. (i.e. zeros are read in) This data is read in by the TOP subroutine.

The area of the settling pond or clarifier is read in (for industrial treatment). This area is in acres and is read in with the statements:

READ 20, AREA

20 FORMAT (F5.2)

The card layout for an 8 acre pond is
/ 2 3 4 5 6 7

| 181.10101 | |

If the treatment is for industrial waste and involves acid or caustic neutralization the next card supplies the value for MNEUT.

MNEUT = 1 for acid neutralization and

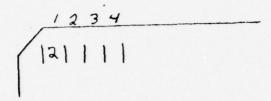
MNEUT = 2 for caustic neutralization

MNEUT is read in with the following statements

READ 21, MNEUT

21 FORMAT (II)

The card layout for MNEUT = 2 is



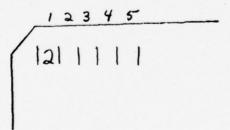
If the treatment is acid neutralization, then MENU indicates the neutralizing agent.

MENU is read in with the following statements:

READ 22, MENU

22 FORMAT (II)

The card layout for MENU = 2 is



If the treatment is caustic neutralization, then NCAUS indicates the neutralizing agent

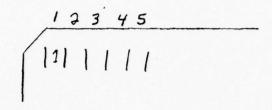
$$H_2SO_4$$
, HCI or HNO_3 - 1

NCAUS is read in with the following statements:

READ 23, NCAUS

23 FORMAT (II)

The card layout for NCAUS = 1 is



If NCAUS = 1 then MACY gives the neutralization agent

 H_2SO_4 - 1 = MACY

+CI - 2 = MACy

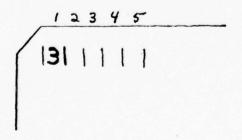
 HNO_3 - 3 = MACY

MACY is read in with the following statements

READ 24, MACY

24 FORMAT (II)

The card layout for MACY = 3 is



If the treatment is for domestic waste there are two types modeled, trickling filter and activated sludge. ITYPE supplies the program with this information

ITYPE = 0 trickling filter

ITYPE = 1 activated sludge

ITYPE is read in with the following statements:

READ 25, ITYPE

25 FORMAT, (I1)

The domestic treatment data is read in on two cards. Appropriate numbers are entered for the particular type of treatment used. The appropriate data for each type is as follows:

TRICKLING FILTER

AREP primary clarifier area in acres

TVOL trickling filter volume in acre-feet

TEMP wastewater temperature in °C

R2 recycle from filter effluent (MGD)

R3 recycle from secondary clarifier (MGD)

R4 recycle to filter (MGD)

TFAREA trickling filter area in acres

K20 = 0.23 for 1" rack media

= 0.13 for 2½" rock media

AREAS secondary clarifier area in acres

ACTIVATED SLUDGE

AREP as above

AREA as above

ABVOL aeration basin volume (MG)

MLSS mixed liquor suspended solids (mg/1)

YN net yield from plant log data

Rl activated sludge recycle (MGD)

The data are read in with the following statements:

READ 26, TEMP, AREAP, AREAS, ABVOL, TFAREA, TFVOL

26 FORMAT (F9.3, 1X, F9.3, 1X, F9.3, 1X, F9.3, 1X, F9.3, 1X, F9.3)

READ 27, MLSS, YN, R1, R2, R3, R4

27 FORMAT (F9.3, 1X, F9.3, 1X, F9.3, 1X, F9.3, 1X, F9.3, 1X, F9.3)

The card layout illustrating the first two of these values TEMP = 20° C and AREAP = 5 acres is as follows:

123456789101112

1 1 1 12 0 1 0 0 0 0 1 1 1 1 1 15 1 0 0 0 0 1

Next the flagging data discussed above is read in by the FLAG(P) subroutine. First the X flagging level is read in for each parameter of the survey in the same parameter order used in previous data. All X's are read in on the same card with the statements:

READ (1,900) (FLGPT (I), I = 1, (NP) 900 FORMAT (25F3.2) and for flag levels of .10, .10, .10, .99, .05 etc., the card layout is:

The manual flagging is done in two parts, the flags for the sources and the flags for the branches. First a card reads in NF the number of flags for parameters to be measured at sources, then the cards which designate the source number $\mathsf{NX}(\mathsf{I})$ and the parameter number of that source $\mathsf{NY}(\mathsf{I})$ as determined by the consecutive ordering, not the master list number. One card is used for each pair to be designated. The NF is the number of pairs to be read in. The statement and the card layout follow:

903 FORMAT (I2)

For 9 source flags the card layout is:

60 READ (1, 904) NX(I), NY(I)

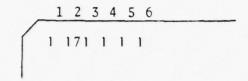
904 FORMAT (I2, 1X, I2)

The card flagging source 3 parameter 11 follows:

In similar manner the branch flags are entered READ 903, NFB

903 FORMAT (12)

For 7 branch flags the card layout is



DI 81 I = 1, NFB

81 READ 904, NX(I), NY(I)

904 FORMAT (I2, 1X, I2)

The card flagging branch 5 parameter 12 follows

This completes the data called by the START and TOP and their subroutines.

RESOURCE MATCHING MODEL USER'S GUIDE

1. Data Required:

Data required by the resource matching model can be divided into two classifications. First, there is data generated in the process and topology models; and secondly, there is data that must be supplied by the user.

The data generated in the process and topology model are the parameter concentrations or other measure number for each parameter for each branch of the system. These values are computed for a given set of process states and are available to the resource matching program and its subroutines through the common dimension statements.

The data to be supplied by the user consists of the following:

- *1. The number of measure methods available for each parameter $(\mathsf{NMA}(\mathsf{N}))$
- *2. The sampling frequency for each parameter (SAMFRE(N))
- The number of pieces of equipment in all resource data (NPOFEQ)
- 4. The names of the pieces of equipment and time constraints on each piece (EQNAME), (EQTIME)
- The data defining the measurement methods for each parameter (PMDATA)
- 6. Constraints other than on pieces of equipment
- 7. Sampler assignments
- 8. Flow measurement data

^{*}This information was supplied to a subroutine of the TOP program, CHKI, but it is used here.

- 1. EXPD SCALE PH MET
- 2. VIS SPECTROPHOT
- 3. PH PREPARATION
- 4. PH MEASUREMENT
- 5. AUTOMATIC BURET
- 6. HEATER, EXTRACT RACK
- 7. CONDUCTIVITY METER
- 8. ANAL BALANCE
- 9. OVEN (105C)
- 10. Oven (180C)
- 11. DESSICATOR
- 12. TECHNICON
- 13. CARBON ANALYZER
- 14. BLENDER
- 15. LAB HOOD
- 16. KJDL DIGEST RACK
- 17. VACUUM SOURCE
- 18. MAGNETIC STIRRER
- 19. NEPHELOMETER (HACH)
- 20. SEPERATORY FUNNELS
- 21. FUNNEL RACK
- 22. MUFFLE FURNACE
- 23. AA SPECTROPHOT
- 24. TECH AUTOANALYZER
- 25. GAS CHROM WI FID
- 26. CENTRIFUGE
- 27. HACH TURBIDMETER
- 28. HOTPLATE

EQUIPMENT INCLUDED IN THE RESOURCE MODELS

TABLE III

For each parameter to be measured there are 1 to 3 methods defined for making the measurement. The different methods may involve different techniques, different equipment or different personnel. The number of methods available for each parameter is needed and is read in as NMA(N).

A sampling frequency, SAMFRE(N), is required for each parameter. This is the number of samples measured per day per measure point for the given parameter. When the commitment of equipment and personnel per sample is combined with the total number of sample points and the samples per day for the length of the survey the total commitment for that parameter is determined for the survey.

The resources available for use in planning a survey are defined in a resource model. The resource model defines one to three measurement methods for each parameter. Each measure method model lists the following information about that method in matrix form: (Figure IX)

- 1. Parameter name
- 2. Method name and number
- 3. Minimum acceptable concentration
- 4. Equipment items (name and number)
- 5. Time commitment of personnel and equipment for sample
- 6. Space commitment
- Miscellaneous, including cost, set-up time, location of tests, and time period in which tests must be run.

This data is supplied to the program in the Resource Matching subroutine.

The cards defining measure methods for each parameter should be considered a library of methods and the library can be updated by including the latest or best values on the method cards used.

ANALYSIS 2	ION 0.0500	MISCELLANEOUS	0.0 COST SAMPLE	10.0 SET-UP TIME	1.00 WHERE ANALYSIS DONE	24.00 TIME CONSTRAINT	ION 0.0500	MISCELLANEOUS	0.0 COST SAMPLE	10.0 SET-UP TIME.	1.00 WHERE ANALYSIS DONE	24.00 TIME CONSTRAINT	64
NUMBER OF METHODS AVAILABLE FOR ANALYSIS	CEPTABLE CONCENTRATION	AVG. ANALYSTS TIME/SAMPLE	0.0 Class 1	0.0 Class 2	8.0 Class 3	0.0 Class 4	MINIMUM ACCEPTABLE CONCENTRATION	AVG. ANALYSTS TIME/SAMPLE	0.0 Class 1	2.50 Class 2	10.00 Class 3	0.0 Class 4	HOD DATA
NUMBER OF MET	MINIMUM ACCEPTABLE	VAN SPACE	10.00	0.0	0.0	0.0	MINIMUM AC	VAN SPACE	10.00	0.0	0.0	0.0	PM DATA ER MEASURE METHOD DATA FIGURE IX
N-(2	ION ELECTRODE	EQ. TIME PER SAMPLE	2.00	2.00	0.0	0.0	ш	EQ. TIME PER SAMPLE	0.50	0.0	0.0	0.0	PARAMETER
AMMONIA (NH3)-N	SPEC. ION E	CODE	1	2	0	0	132C PHENATE	CODE #	8	0	0	0	
PARAMETER NAME	METHOD I NAME	EQUIPMENT NAME	EXPD SCALE PH MET	SPEC ION ELECTRODE			METHOD 2 NAME	EQUIPMENT NAME	VIS SPECTROPHOT				

The program reads resource information in as follows:

- The number of pieces of equipment included in all measure methods is read in. (NPOFEQ)
- 2. The names of the pieces of equipment are read in along with the total amount of time available for the survey on that piece of equipment (the order in which pieces of equipment are read in assigns them a number). EQNAME(I), EQTIME(I).
- 3. The parameter method data is now read in in matrix form. One set of five cards for each method for each parameter. The first card for each parameter gives the method name and the minimum concentration. (MENAME) (PCRM). The next four cards read in the five numbers on each line of the PMDATA model illustrated in Figure IX. One line is read in per card. (PMDATA)

The next resource matching data required is a listing of constraints other than those already listed for each piece of equipment. These constraints are given on a total survey basis and are: Total Van Space, analysts (1) time, analyst (2) time, analyst (3) time, analyst (4) time and cost. The different classes of analysts have been defined by AEHA Chemists in terms of abilities and preferences for performing certain functions. Analyst (Class I), for example, would be used to collect samples and subdivide them into test size samples. Analyst (Class 2) could perform most routine analyses. Analyst (Class 3) could perform the more complicated analyses and would be used on routine analyses only as second choice. Analyst (Class 4) mostly supervisory but could fill in for Class 2 and 3 if needed.

If the data for the van space is properly defined, this information can be used to determine if additional facilities

will be needed for the survey, (e.g., additional wet chemistry laboratory facilities).

Other resources in the survey separate from the analytical chemistry are the resources required for collecting the samples. These resources include sampler equipment, equipment time, and personnel time commitment to collect the samples. The information required by the SAMPLE subroutine is shown in Table IV. The personnel time requires a commitment of analyst (Class I) time.

#	Sampler Name	Time/Sample	Set-Up Time
1	EASY GRAB	5.0	5.0
2	HARD GRAB	15.0	5.0
3	1500	20.0	5.0
4	PROTECH	5.0	5.0

SAMPLER DATA
TABLE JV

In addition to the sampler data of Table IV, the survey officer must decide during the preliminary survey which samplers will be used at each branch if the survey plan calls for a measurement at that branch. This data is supplied to the SAMPLE subroutine by reading in the appropriate sampler number from the left-hand column of Table IV for each branch. NROUT(1).

The last items of data required are for the flow measurement. The flow measure method, time per measurement and set-up time are given in Table V.

#	Flow Meter	Time/Meas.	Set-up Time
1	Stevens Recorder		20.0
2	Gurley Meter		30.0

FLOW METER DATA Table V

This information is supplied to the SAMPLE subroutine. In addition, the survey officer must decide for each branch if a flow measurement is to be made and if the measurement is to be made will meter type #1 or #2 be used. This information is supplied to the program by reading in for each branch a zero for no measurement, a one for a measurement using a Stevens recorder, or a two for a measurement with a Gurley meter.

II. Data Format

The formats and card layout for reading in the resource matching data is given next.

The first card read in by the resource matching model is the one giving the number of pieces of equipment in PMDATA.

This is NPOFEQ and is read in by statements

READ 135, NPOFEQ

135 FORMAT (13)

the card layout for 32 pieces is

The next group of cards list equipment names and the time

available on that item of equipment. Two items of equipment per card (one item shown). See Figure XIX.

READ 145, ((EQNAME (I,J) J = 1,5), EQTIME (I), I = 1, NPOFEQ) 145 FORMAT (2(5A4, F10.1, 10X))

1 2 3 4 5 6 7

20

30 40

The next set of data cards contain the parameter measurement method data (PMDATA).

Five cards are used for each parameter for each method.

The first in each group of five gives the method name and the minimum concentrations required by the method. The read and format statement are:

READ 410, (MENAME (N, J, II), II = 1,5), PCRM (N,J) 410 FORMAT (5X, 5A4, F10.5)

Example Card

5

25

35

MENAME (N,J)

PCRM (N,J)

Nth parameter Jth method

The next four cards supply the four lines of data of the parameter measure method matrix; One line/card in proper order. The read-in and format statement are:

D030 L = 1,4

30 READ 430, (PMDATA (N, J, L, L1), L1 = 1,5)

430 FORMAT (F5.0, F10.2, F10.3, F10.2, F10.3)

Example card for first line of data

The other three lines are read in on the next three cards as L iterates from 1 to 4.

If there is a second method (J) for the same parameter (N), PMDATA is read in for the next method (five cards). The next parameter is then considered as N goes to N + 1.

After all of the PMDATA cards, the constraint card follows. This lists any constraints on Van space, analyst's time, costs or other. This program is set up to consider six constraints in addition to the constraints on equipment time.

The read and format statement are:

READ 650, (CNSTAR (M), M = 1,6)

650 FORMAT (4F 20.3)

Example card

20

40

60

80

VAN SPACE

ANAL 1

ANAL 2

ANAL 3

A second card using the same format is required to list ANAL 4 and cost constraints.

The format for reading in the sampler name, sample time and set-up time is illustrated by the statements

D030 I = 1,4

30 READ 903, (NSAMPL (I, K), K = 1,5) SAMPTI (I), SET UP (I) 903 FORMAT (5A4, 2F6.1)

An example card for reading in EASY GRAB, 5.0 minutes per sample, and 5.0 minutes set-up time is shown

1 2 3 4 5 6 7 8 9

26

32

|E|A|S|Y| |G|R|A|B| - | |5|.|0| - | |5|.|0|

The listing of the sampler type to be used for each branch if a sample is to be taken at that branch is read in by the following statements

READ 906, (NROUT (I), I = 1,NB)

906 FORMAT (4012)

The card layout for reading in sampler 1 for branch 1, sampler 3 for branch 2, etc.

1 2 3 4 5 6 7 8

1 | 3 | 1 | 2 |

The format for reading in the flow meter name, sample time, and set-up time is given by the statements (this is an extension of the sampler read in).

D050 I = 5, 6

50 READ 903, (NSAMPL (I_nK), K = 1,5), SAMPTI(I), SET UP(I)

903 FORMAT (5A4, 2F6.1)

An example card for reading in STEVENS RECORDER, O sample time and 20.0 minutes set-up time is shown

1 2 3 4 5 6

26

32

|S|T|E|V|E|N|S| |R|E|C|O|R|D|E|R| - |0|.|0| - |2|0|.|0|

The listing of the flow measure method to be used for each branch

READ 906, (NFLOW(I), I = 1, NB)

906 FORMAT (40I2)

Example card with no flow reading on branches 1, 2, 4, 5, and a Stevens recorder on 3 and a Gurley meter on 6.

1 2 3 4 5 6 7 8

|0| |0| |1| |0| |0| |2| 2 other branches

MODEL VERIFICATION AND/OR UPDATING

INTRODUCTION

The model verification and or updating is done using the CORRCT subroutine.

The CORRCT subroutine accepts site measurement data, compares it with model predicted measurement data and computes and prints out suggested new values for the parameters of the process models.

The subroutine CORRCT is used in conjunction with the program subroutines which make up the site model. They are MAIN, PROCES, START, TOP, NEUTRA, SETTLE, DOME, CHKI, and CHK 2.

The site model package with CORRCT has two objectives. First, the process models can be updated or improved using preliminary survey data. While the best data available were used in constructing the process models, there was considerable variation in data for a given process from one plant to another or from one season to another. Better process model values may be obtained with CORRCT using measurements from judiciously selected grab samples taken on a preliminary survey. The output of CORRCT lists new values for certain process parameters. If the survey officer wishes, he may enter these new values into the process models using procedures outlined in the discussion of the PROCES subroutine.

A second use of the site model package with CORRCT would be verification of the model. After the survey, measurements are available for obtaining max, min, average or other expected values for each parameter at each branch for known levels of production. These values can be entered into the site model package with CORRCT to determine values for process model parameters which can be used to verify the model or refine the model as appropriate.

With confidence in the model, one can now use it to predict levels of potential pollutants for production levels other than those which occurred during the survey. This should give added significance to the survey report.

Ideally, if measurements are to be made to verify the process models, the measurepoints should be chosen such that each process will be determined uniquely by the measurements. However, if the survey officer who determines the measure points does not visualize the system in terms of the same processes as are used in the process model, measurements may not uniquely determine process parameters. The program is designed to accept such non-unique measurement data and uniquely determine processes, where possible, and make approximations on other processes informing the user of the determination is non-unique.

The measure points for uniquely determining all processes can be identified by referring to the linear graph of the system (Figure III for example) which display all processes and all possible measure points. On the linear graph, identify all of the vertices (junctions) nearest to the processes.

If at a vertex there are N branches incident to a vertex, then measurements must be taken or implied at N-1 of these branches. By taking N-1 measurements, the Nth measurement is implied. Note that one of the N-1 measurements at a vertex A may be implied by measurements at a vertex B or other vertices.

II. INPUT DATA AND OUTPUT DATA

After the decisions are made which determine where measurements are to be made, this information is supplied to the CORRCT subroutine in the form of the MESUR(I) matrix. The MESUR(I) matrix contains a "O" for each branch where measurements are not taken and a "I" for each branch where measurements are taken.

It may not be appropriate or even possible to check every parameter in a process model. The subroutine CORRCT only applies to conservative parameters [i.e. only those measured in mass terms (mg/1) or flow]. The program allows the user to select the one, two, or several (up to 20) parameters to be included in each model verification. The parameters to be considered in a particular study are identified by their numbers in the master list of Table II. The Flows must be included in any branch where other parameters are considered.

The number of parameters and the parameter numbers are supplied to CORRCT for each branch where measurements are to be taken using BPLIST (IB,N), where IB is the branch number and N is the parameter number. The first number N for each branch is the number of parameters considered in that branch. The subsequent numbers N are the parameter numbers for that branch.

The next inputs to CORRCT are the measured parameter values YM(IB,N). For each branch IB the first value, for N=1, must be the flow in MGD. The remaining YM(IB,N) input for a branch are the measure values of the parameters listed in BPLIST(IB,N).

The subroutine CORRCT output lists each source (process) by number, notes if the determination is unique or estimated, and gives the old parameter and the suggested new parameter for each parameter verified. If the determination is unique, the branch where the defining measurement was taken is listed.

III. DATA FORMAT

The data required by CORRCT is:

- 1. MESUR(I), indicating if a measurement is made in branch I
- BPLIST(IB,N) listing for N=1, the number of parameters to be verified in this branch and for other N is the parameter numbers for parameters to be verified for branch IB.

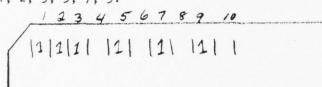
3. YM(IB,N), listing for N=1, the flow in branch IB and for other N's the measurement values for each parameter listed in BPLIST(IB,N).

MESUR(I) is read in by:

$$READ(1,1)$$
 (MESUR(I), I = 1, NB)

1 FORMAT (80 I 1)

Card layout for measurements in branches.



BPLIST(IB,N) and YM(IB,N): are read in one branch at a time by the statements.

DO 2 IB = 1, NB

IF (MESUR(IB). EQ. 0) GO TO 2

READ (1,3) (BPLIST (IB,N), N = 1,20

3 FORMAT (20I 2)

IBPLIST = BPLIST (IB, 1)

READ(1,4) YM (IB,N), N = 1, BPLIST

4 FORMAT (F 20.6)

Card layout for two measurements on a branch IB, one flow and the other acidity. Note the parameter number for flow does not exist and is not given in BPLIST. (Acidity number is 24)

BPLIST Card

YM card for flow = 0.78 and acidity = 25.

Review of Input Data

The Diagrams on the next three pages serve as a review of the data required by the Survey Planning Program and also it serves to emphasize that the order in which the data is read in must be exactly as shown in these diagrams.

ORDERING OF INPUT DATA

MASTER = largest parameter number NFLG Flag to bypass RM EPSLON Flag to call CORRCT N the number of procener in the plast model XNAME (JM), CAP (JM) process model name and capacity and card per process in topological NOD Flag to indicate modifications NMOD The number of modifications YNAME (NM), ELE(MN), VAL (NM) Process name, parameter member, parameter value. One card per modification NPRO Flag to indicate complete processes to be changes Number of parameter in the master list NUMP ZNAME (JN), FLW (JN) Name and Flow of processes to be changed SPLIST (JE, JK) Parameter value, one card for each parameter in the master list for each changed process. NS, NB, NP, NTOP The number of sources, branches, parameters, and outfalls NPLIST (I) List of the pollutent number used A(J,I)The topology matrix, one card per row NBRANCH Branch names LENGTH Length of survey is days

ISTOP The nubmer of non-competing parameters

POLN, NMA, SAMFRE The names of all parameters in the master up to MASTER, the number of measure methods avoilable and the sampling frequency

Treatment Facilities Data

AREA, MNEUT, MENU, NCAUS, MACY, ITYPE, TEMP, AREAP, AREAS, ABVOL, TFAREA, TFVOL, MLSS, R1, R2, R3, R4.

FLGPT The flagging level is read in for each parameter

NF The number of manual source flags

NX, NY The source and parameter flagged one card for each NF

NFB The number of manual branch flags

 $\ensuremath{\mathsf{NX}}$, $\ensuremath{\mathsf{NY}}$ The branch and parameter flagged one card for each $\ensuremath{\mathsf{NFB}}$

NPOFEQ The number of pieces of equipment in the resource data

EQNAME, EQTIME Equipment name and time avoilable during survey

MENAME, PCRM Method name and minimum concentration for each parameter for each method

PMDATA Method resource data - four cards for each parameter for each method

CNSTAR Lists constraints on van space, analysts time, etc, two cards

NSAMPLE, SAMPTI, SETUP Sampler name, time per sample, set up time for each type of sampler

NROUT List the sampler to be used for each branch if a sample may be taken there

NSAMPL, SAMPTI, SETUP Flow meter name, sample time, and set up time for each type of meter

NFLOW Lists the flow meter to be used for each branch where a reading may be taken

MEASUR Lists branches where measurement data is taken

BPLIST For each branch measured, give the number of parameters to be verified and lists them by numbers.

YM Gives the appropriate measured values.

Output Data

The output data falls into two general classifications, output which affirms the input data and output which is a result of analysis. In this section the output data will be reviewed. If the data is a reiteration of input, it will be identified and no further discussion will be given. Other output will be considered in more detail.

All of the output data shown on Figure X are reiterations of input data. The first 10 lines give the mnemonics of the processes in the survey and their operating levels. The "l" in line eleven indicates that a process model is to be altered. The "l" in line 12 indicates that there is to be one alteration. Line 13 defines that change. The "l" in line 14 indicates that there are new processes to be read in.

The output data shown on Figure XI are mostly reiterations of input data. The first line is NP, the number of parameters to be measured in the survey. The second line indicates that the survey planning period is one day. The remaining 17 lines list the parameters to be measured on this survey, their assigned number, (left hand column), NMA and SAMFRE. The last column on the right gives the total number of samples per point. This is the product of sample frequency and the length of the survey in days.

Figure XII shows the next groups of output data. All of these are reiterations of input with an ordering assignment.

for the processes. At the top of the page three numbers, NS, NB, and NTOP are given. The next block of output is a relisting of the topology matrix, A(J,I). The last group in this figure is headed pollutant matrix data which lists the process names, their assigned number and their flows in MGD.

The next block of data is illustrated in Figure XIII.

It is a listing of each source mnemonic, its assigned number and the parameter value for each of the pollutants for each process. This is essentially a reiteration of the input process data.

The output data in Figure XIV illustrates the flagging information. The first block of data gives the flagging levels for each parameter for automatic flagging. The second block of data is a list of the manual flags at sources. Not shown but also part of the output is a listing of the manual flags at the branches.

Figure XV lists the assigned branch numbers and names and also includes the calculated flow for each branch.

Figure XVI lists, at the top of the page, the number of branches, NB, and the number of parameters, NP, in the study. The remaining data on the Figure XVI illustrates the results of the TOP calculations. For each branch the name and number of the branch is listed and along with this the parameter value is listed for each pollutant in the study. The negative signs on certain of the numbers is not to be interpreted as indicating negative values. Rather, it is an indication that

this parameter is flagged for that particular branch. Figure XVI gives only an illustrative sample of this output data.

Figure XVII lists the mass in pounds per day that passes through each branch of the system. This mass number is meaningful for such parameters as TOC and NITRITE/NITRATE but has no meaning in the case of pH and Conductivity. Again the negative numbers are flagged points and not negative quantities.

Figure XVIII shows the ordering of the measure points as done by the level subroutine. This data tells the number of measure points required to detect all of a parameter if measurements are made at levels different from the outfall. For example, if the measurements are to be made at level 2 then there are three measure points required.

Figure XIX is a reiteration of input data including NPOFEQ, equipment name and number, and time available on each piece of equipment.

Figure XX illustrates the next groups of data read out.

This is the PMDATA, the measurement method data for each measure method. This is read out for each parameter for each method.

Figure XXI is a reiteration of the constraint data input.

The next output data is a listing of each branch of the system and the parameters that are to be measured at each branch. Figure XXII illustrates this output for several branches.

Figure XXIII lists the sampler data at the top. The figure also lists computed sampler commitment for each branch

as a result of the completed survey plan.

Figure XXIV lists the flow meter data at the top of the page. The figure also lists computed flow meter time commitments as a result of the completed survey plan.

The next group of data is illustrated by Figure XXV.

This output lists the following data for each parameter measured:

- (1) The parameter name at the upper left corner.
- (2) At the upper right corner the output lists the branches in which the measurements are to be made in the survey, the measure method to be used at each branch, and the expected value of the parameter at that branch. The asterisks indicate flagged measure points.
- (3) The total number of samples of that parameter during the survey planning period.
- (4) The items of equipment required in measuring this parameter, the total time commitment on each for these measurements, and an indication if a time constraint was violated (for the survey, as a whole, does not indicate at which parameter the violation occurred).
- (5) The time commitment of each of the types of analyst in making these measurements and an indication of time constraints violated.

Figure XXVI shows the read out data which is a summing up of total commitments of all the equipment and analysts for the total survey planning period. Along with the total commitments, violations are indicated and the amount noted.

Figure XXVII shows the output data of the CORRCT subroutines. When CORRCT is used the usual site model output from TOP is read out and in addition the data in the form of Figure XXVII is output to give the suggested new values for process parameters. There are two types of outputs. In one type where the values are determined directly from measurements, values are listed as unique determinations. For other types, where the values cannot be determined directly from measurements, values are listed as estimated values.

PCIX	90.00
PZBM	90.00
PCWB	90.00
PAPN	100.00
PNDN	100.00
PGRB	100.00
PSAZ	100.00
PTNT	100.00
PPHZ	90.00
PSTP	100.00
1	
1	
PCIX 12	10000.00
1	

PROCESS LEVEL
OUTPUT DATA
FIGURE X

PARAMETER # PARAMETER NAME # DF METHODS AVAIL. FOR ANAL. # DF SAMPLES TO BE ANALYZED/DAY/SAMPLE POINTINIAL #300 12:0 2 CONDUCTIVITY 3 CONDUCTIVITY 4:0 4:0 5 TOTAL NILSHDAHL) 5 TOTAL NILSHDAHL) 6 SULFATES 7 SULFATES 8 CHLORIDES 9 CHLORIDES 10 VCL SUSP SOLIDS 11 TOTAL PHOSPHATES 11 TOTAL PHOSPHATES 12 TATAL HITTERS 13 CALCIUM 14 ALKALHITY 15 TURBIDITY 16 TURBIDITY 17 TURBIDITY 18 TURBIDITY 19 TURBIDITY 19 TURBIDITY 10
0

THE NUMBER OF PARAMETERS # 16
THE FIRST & ARE NON-COMPETING PARAMETERS

PARAMETER OUTPUT DATA

Figure XI

TOPOLOGICAL DEFINITION DATA

NUMBER OF OUTFALLS	1
NUMBER OF BRANCHES	18
NUMBER OF SOURCES	13

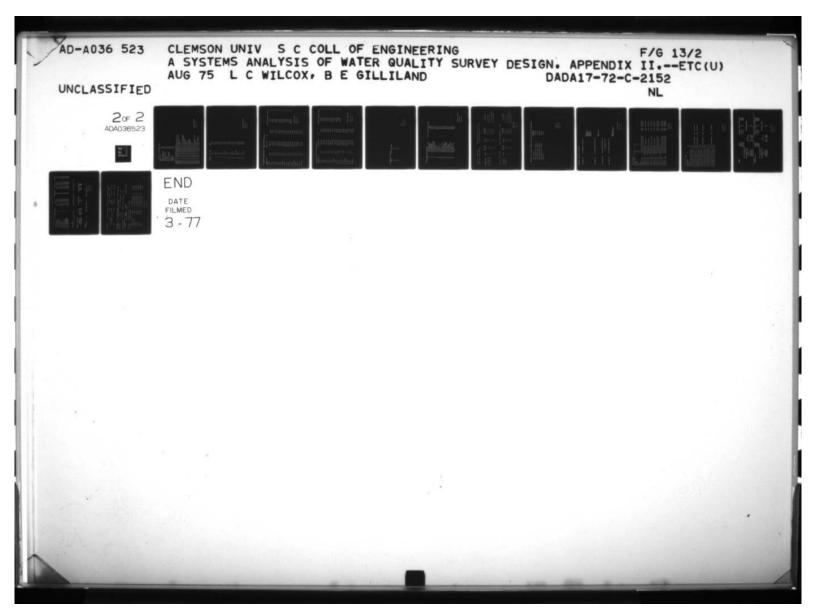
TOPOLOGY MATRIX DATA

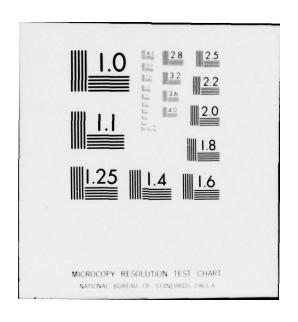
1010101010125005	10101010101010125005	911010101010125305	00011010101010125005	005051101010125305	000000011910125965	000000000110125005	00000000001125005	000000000000000000000000000000000000000	000000000000000000
PCIX	WH7d	PCWB	PAPN	PNON	PGKB	PSA2	PINI	ZHdd	PSIP
7	2	3	4	2	9	1	8	6	2
SOURCE	SOURCE	SOURCE	SOURCE	SOURCE	SUURCE	SOURCE	SOURCE	SOURCE	SOURCEI

POLLUTANT MATRIX DATA

					TOPOLOGY AND PROCESS FLOWS	VIV. 10.1100	Figure All
0.289	0.000	0.153	0.300	0.300	0.002	0.300	0.100
FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW
PCIX	P 2 B M	PCWB	PAPN	MONd	РСКВ	PSAL	PINI
-	2	3	4	5	9	1	33
SOURCE 1 PCIX	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE 7 PSAZ	SOURCE 8 PINT

VOL SUSP SOLIDS	1.000	5.300	1.000	1.000	1.000	2.000	2.000	5.000	2.000	10.000	ACIDITY	500.000	80.000				PROCESS-PARAMETER	OUTPUT DATA	Figure XIII		
CHLORIDES	35.000	30.000	100.000	15.000	25.000	15.000	15.000	1500.000	20.000	28.000	TURBIDITY	3.000	5.300	3.000	10,000	10.000	2.000	10.300	2.000	8.000	12.000
S SULFATES	10000.0001	2500.000	500,000	600.009	1000.000	100.000	96000.000	2500.000	249.009	120.000	ALKALINITY	0.0	200.000	100.000	60.000	0.0	0.6	0.0	0.0	200.000	19.00%
PARAMETER SUSPENDED SOLIDS SOURCE	3.909	3.000	3.000	5.003	5.000	10.000	16.600	16.000	10.009	12.000	CALCIUM	2000-000	0.0	20,300	20.003	20.0CL	20.000	20.000	20,000	1,000	
PARAMETER	1 PCIX	2 PZ8M	3 PCWB	4 PAPN	NONG S	6 PGRB	7 PSAZ	B PINI	7Hdd 6	Ly PSTP	PARAMETER SOURCE	1 PC1X	2 PZ8M	3 PCWB	4 PAPN	NONA S					





MINIMUM FLAG LEVELS	0.	0.	.10	.10	.10	66.	66.	.05	.10	66.	66.	.1.9	.10	66.	66.	66.
PARAMETER MINIM	Н	CONDUCTIVITY	100	NITRITE/WITRATE(N)	TOTAL NIKJEHDAHL)	TOTAL SCLIUS	SUSPENDED SOLIDS	SULFATES	CHLORIDES	VOL SUSP SOLIDS	TUTAL PHUSPHATES	TNT	CALCIUM	ALKALINITY	TURBIDITY	ACIDITY

NITRITE/NITRATE(N) PARAMETER IS NITRITE/NITRATE(N) IS NITRITE/NITRATE(N) IS NITRITE/NITRATE(N) TOTAL NIKJEHDAHL) TOTAL PHOSPHATES TOTAL SOLIDS TOTAL SOLIDS ALKAL INI TY CHLORIDES TURBIDITY IS SULFATES SULFATES SULFATES CALCIUM ACIUITY TNI TOC 100 171 IS TOC IS TNT TNI IS TOC SI S OF FLAGGED POINTS IS 32 SI 5 1 SI 15 S PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PAKAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PASAMETER PARAMETER PAKAMETER PARAMETER PARAMETER PARAMETER PARAMETER PARAMETER PAPN THE HE HE THE THE THE PADA PGAB PGRB PGRB PCRB PSTP MOND PNUN PGRB PGRB PGRB PGRB PCRB 8 Coll PSAZ PINI 11.19 7Hdd MONd PGAB PSAL PINT PINI 1Hdd THE NUMBER 2 9 9 9 99 9 9 99 9 ~ ~ @ 8 8 SOURCE SOURCE SOURCE SOURCE SUURCE SOURCE SOURCE SOURCE SUUNCE SOURCE SOURCE SOURCE SOURCE SOURCE SOURCE SCURCE SUURCE SOURCE SOURCE SOURCE SOURCE SOURCE SUURCE SUURCE SUURCE

FLAGGING INFORMATION
OUTPUT DATA

Figure XIV

FLOW	6.379	6.153	0.532	0.300	0.832	0.300	1.132	0.002	1.134	0.300	1.434	0.10%	1.534	1.534	1.534	0.018	0.500	2.052
BRANCH NO. AND NAME	1x6	CWB	MH1A	AOP	MH2	NON	¥H4	CASUAL	₩HG	SAC	MHID	1N116	PH4	NEUTRAL	POND	рнг	STP	OUTFALL
BRANCH NO.	-	2	3	•	\$	9	1	80	6	10	::	12	13	14	15	91	11	18

BRANCH NAMES AND FLOWS

OUTPUT DATA

Figure XV

OUTPUT POLLUTART DATA MATRIX FROM TOP SURROUTINE NUMBER OF BARAMETERS= 16

- =	PARAMETER PH ELEMENT		CONDUCTIVITY	100	NITRITE/NITRATE(N)	TOTAL NI
-	1 IXG	2.218	12288.078	6.187	7.523	1.
~	2 CWB	7.530	060.006	10.030	10.009	.0
9	3 MH1A	2,365	8928.293	7.283	8.235	-
4	AOP	7.000	000-009	5.090	11.000	•
5	мн2	2.559	5926.234	6.460	9.232	•
•	NON 9	2.000	966.6664	10.000	300.000	5.
1	7 MH4	2,330	5680.820	7.398	86.273	1:
80	8 CASUAL	3.000	-10)0.000	10.000	10.000	
6	9 MHG	2.335	5672.563	7.402	86.138	
10	10 SAC	0.300	199999,938	20.000	0.500	5.
=	11 MH10	796.0	46319.492	10.037	68.226	2.
12	12 TNT16	1.500	966*6666€	40.000	1000.000	8.
13	PH4	0.985	45907.574	11.990		
14	14 NEUTRAL	7.056	8617.082	11.990	BRANCH POLLUTANTS	
15	POND	7.056	8617.082	11.990	OUTPUT DATA	
16	РН2	7.400	666.666	000.6	Figure XVI	
17	STP	7.5.3	800.000	25.000		
18	18 OUTFALL	7.044	6645.766	15.134		

MASS OUTPUT INFORMATION, POUNDS PER DAY

PARAMETER PH ELEMENT		CONDUCTIVITY	100	NITRITE/NITRATE(N)	TOTAL N
1 IXG	0.019	38892.691	19.581	23.812	S
2 CWB	000.	766.107	12.768	12.768	0
3 MH1A	0.019	39658.773	32.349	36.580	9
4 ANP	0.000	15 .2 . 171	12.518	27.540	0
5 MH2	610.0	41160.910	44.867	64.126	5
NON 9	0.025	12518.090	25.036	.751.085	12
7 MH4	0.044	53678.980	506*69	815.206	1.1
8 CASUAL	700.5	169.91	0.167	0.167	0
9 мне	6.544	53675.637	70.070	815.372	11
10 SAC	1.255	500723.688	.50.072	1.252	12
11 MH10	1.299	554419.313	120.143	816.624	30
12 TNT16	0.026	33331.566	33.392		
13 РН4	1.325	587830.375	153.524		
14 NEUTRAL	0.00.0	110333.063	153.524		
15 POND	₩00°.	110333.663	153.524	BRANCH POLLUTANT MASS	SS
16 PH2	3-666	-150.217	1.352		
17 STP	000.0	.3338.158	104.317	OUTPUT DATA	
18 CUTFALL	003.	113821.375	259.193	Figure XVII	

Figure XVIII

OUTPUT DATA

LEVEL

THE TOPOLOGY OF THE SITE
LEVEL # OF TEST POINTS

TOTAL TIME AVAIL./TIME PERIOD 423.9 426.0	420.0 168).4 420.0 425.9	420.0 1440.0 1440.0 1440.0	420.0 420.0 420.0 1440.0	420.0 420.0 1260.0 420.0	420.0 420.0 420.0 420.0 420.0 420.0
EQUIPMENT = 28 EQ. NAME EXPD SCALE PH MET VIS SPECTROPHOT PH PREPARATION	PH MEASUREMENT AUTOMATIC BURET HEATER, EXTRACT RACK COMPUCTIVITY METER	ANAL BALANCE DVEN (155 C) NVEN (187 C) DESSICATOR	TECHNICON CARBUN ANALYZER BLENDER LAB HOOD	KJOL DIGEST RACK VACUUM SOURCE MAGTETIC STIRKER NEPHELOMETER(HACH) SEPERATORY FUNNELS	FUNNEL RACK MUFFLE FURNACE AA SPECTROPHOT TECH AUTDANALYZER2 GAS CHROM WI FID CENTRIFUGE HACH TURBIDMETER
TOTAL # OF ITEMS OF EQ. CODE #	4000	11.09 B	12 13 14 15	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	21 22 23 24 25 26 27 28

EQUIPMENT CONSTRAINTS
OUTPUT DATA
Figure XIX

YSIS 2	0.0500	MISCELLANEOUS	0.0 COST SAMPLE	10.0 SET UP TIME	1.00 WHERE ANALYSIS DONE	24.00 TIME CONSTRAINT	0.0500	MISCELLANEOUS	0.0 COST SAMPLE	10.0 SET UP TIME	1.00 WHERE ANALYSIS DONE	24.00 TIME CONSTRAINT	RESOURCE MODEL OUTPUT DATA	Figure XX
NUMBER OF METHODS AVAILABLE FOR ANALYSIS 2	MINIMUM ACCEPTABLE CONCENTRATION	AVG. ANALYSTS TIME/SAMPLE	0.0 Class l	0.0 Class 2	8.0 Class 3	0.0 Class 4	E CONCENTRATION	AVG. ANALYSTS	0.0 Class 1	2.50 Class 2	10.00 Class 3	0.0 Class 4	RE OI	Fi
NUMBER OF METHOD	MINIMUM ACCE	VAN SPACE	10.00	0.0	0.0	0.0	MINIMUM ACCEPTABLE CONCENTRATION	VAN SPACE	10.00	0.0	0.0	0.0		
N- (ECTRODE	EQ. TIME PER SAMPLE	2.00	2.00	0.0	0.0		EQ. TIME PER SAMPLE	0.50	0.0	0.0	0.0		
AMMONIA (NH3)-N	SPEC. ION ELECTRODE	# 3000	-	2	0	0	132C PHENATE	CODE #	٣	0	c	0		
PARAMETER NAME	METHOD I NAME	EQUIPMENT NAME	EXPD SCALE PH MET	SPEC 10N ELECTRODE			METHOD 2 NAME 13	EQUIPMENT NAME	VIS SPECTROPHOT					

CONSTRAINTS ON AVAILABLE RESOURCES (EXCLUDING EQUIPMENT TIME CONSTRAINTS)

CCNSTRAINT	1000.000	840.000	840.000	1260.000	450.000	100.00
						•
		:	2.1	3)	?	
		(CLASS 1)	(CLASS 2)	(CLASS 3)	(CLASS 4)	
		TIME		TIME	TIME	
	TOTAL VAN SPACE	TOTAL ANALYSTS TIME	TOTAL ANALYSTS TIME	TOTAL ANALYSTS TIME	TOTAL ANALYSTS TIME	COST
	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL COST

CONSTRAINTS
OUTPUT DATA
Figure XXI

PARAMETERS MEASURED AT EACH BRANCH

0

FOR BRANCH IXG THE PARAMET

THE PARAMETERS MEASURED ARE:

CONDUCTIVITY SULFATES CHLORIDES CALCIUM ALKALINITY ACIDITY

FOR BRANCH CWB

THE PARAMETERS MEASURED ARE:

PH CONDUCTIVITY

FOR BRANCH MILLA

THE PARAMETERS MEASURED ARE:

NO MEASUREMENTS MADE

FOR BRANCH AUP

THE PARAMETERS MEASURED ARE:

CONDUCTIVITY NITRITE(N)

BRANCH MEASUREMENTS

OUTPUT DATA

Figure XXII

SAMPLING INFORMATION			To de	
SAMPLING TECHNIQUE	SAMPLE TIME SET UP	SET UP TIME		
EASY GRAB	6.0	5.0		
HARD GRAB	15.0	5.0		
1800	20.0	5.0		
PROTECH	5.0	5.0		
AT BRANCH 1 . IXG	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING EASY GRAB	TAKING 6	65.00 MINUTES
AT BRANCH 2 . CWB	12.00 SAMPLES HERE	12.00 SAMPLES HERE TAKEN USING EASY GRAB	TAKING 6	65.00 MINUTES
AT BRANCH 3 . MHIA	NO SAMPLES WERE TAKEN			
AT BRANCH 4 . AOP	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING ISCO	TAKING 24	245.00 MINUTES
AT BRANCH 5 . MH2	NO SAMPLES WERE TAKEN			
AT BRANCH 6 . NON	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING ISCO	TAKING 24	245.00 MINUTES
AT BRANCH 7 . MH4	NO SAMPLES WERE TAKEN			
AT BRANCH 8 . CASUAL	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING EASY GRAB	TAKING 6	65.00 MINUTES
AT BRANCH 9 . MHG	NO SAMPLES WERE TAKEN			
AT BRANCH 10 . SAC	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING ISCO	TAKING 24	245.00 MINUTES
AT BRANCH 11 . MH10	NO SAMPLES WERE TAKEN			
AT BRANCH 12 . TNT16	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING HARD GRAB	TAKING 18	185.00 MINUTES
AT BRANCH 13 , PH4	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING ISCO	TAKING 24	245.00 MINUTES
AT BRANCH 14 . NEUTRAL	NO SAMPLES WERE TAKEN			
AT BRANCH 15 , POND	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING PROTECH	TAKING 6	65.00 MINUTES
AT BRANCH 16 . PH2	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING EASY GRAB	TAKING 6	65.00 MINUTES
AT BRANCH 17 . STP	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING EASY GRAB	TAKING 6	65.00 MINUTES
AT BRANCH 18 , DUTFALL	12.00 SAMPLES WERE	12.00 SAMPLES WERE TAKEN USING EASY GRAB	TAKING. 6	65.00 MINUTES

SAMPLER DATA OUTPUT DATA

Figure XXIII

The state of the s				
TON REASONERS INTOKHALION				
STEVENS RECORDER 0.0	20.0	•		
GURLEY METER 0.0	30.0			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	1 1×6			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	2 CWB			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	3 MH1A			
FLOW WAS MEASURED AT BRANCH 4 , AOP	USING THE ST	USING THE STEVENS RECORDER	TAKING	20.00
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	5 MH2			
FLOW WAS MEASURED AT BRANCH 6 , NDN	USING THE ST	USING THE STEVENS RECORDER	TAKING	20.00
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	7 MH4			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	8 CASUAL			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH	9 MHG			
FLOW WAS MEASURED AT BRANCH 10 , SAC	USING THE ST	USING THE STEVENS RECORDER	TAKING	20.00
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 11	11 MH10			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 12	12 TNT16			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 13	13 рн4			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 14	14 NEUTRAL	•		
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 15	15 POND			
FLOW WAS MEASURED AT BRANCH 16 , PH2	USING THE ST	USING THE STEVENS RECORDER	TAKING	20.00
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 17	17 STP			
NO FLOW MEASUREMENTS WERE MADE AT BRANCH 18	18 OUTFALL			

MINUTES

MINUTES

7-4 1-4 7 3 5-3

MINUTES

MINUTES

FLOW MEASUREMENT OUTPUT DATA Figure XXIV

MEASURE POINT BRANCH NO. EXPECIED YALWE (1, 1) 18 18 15.134 (2, 1) 17 25.000 (0.000) (MAS. CONSTRBINT VIOLATED NINS. NO NO NO	HINS. HINS. HINS. HINS. NO NO NO NO	#EASUBE_POINT. BRANCH_ND EXPECIED_YALUE (1, 1)	MAS_CONSIBALMI_VIOLATED NINS.	HINS. HINS. HINS. HINS. NO
	TIMES S. 36 S. 0	0 250		NES 12	0000
	O HRS.	0 HRS. 1 HRS. 2 HRS. 0 HRS.		I HRS.	0 HRS. 3 HRS. 0 HRS.
METUDD 1384 ORG C 1384 ORG C 24.0 SAMPLES	IDIAL_RESOURCES_ASSIGNED ITEMS 1 CARBON ANALYZER 2 BLENDER	ANALYST CLASSIFICATION 1 CLASSIFICATION 2 CLASSIFICATION 3 CLASSIFICATION 4	MAMETER MITRITE/NITRATE(N) TECHNICON TECHNICON	IDIAL_BESUUBCES_ASSIGNED ITEMS I TECHNICON	ANALYST CLASSIFICATION 1 CLASSIFICATION 2 CLASSIFICATION 3 CLASSIFICATION 4
PABAMETER TOC			PABAMEIEB Nitrite/		

SURVEY COMMITMENTS

OUTPUT DATA Figure XXV

OUTPUT DATA

Figure XXVI

AMUNT OF VAN SPACE	SUL O NING		HRS. O MINS.	HPS. 0 MINS.	HRS. O MINS.	HRS. O MINS.	O MINS.	HRS. 0 MINS.	HRS. 40 MINS.	HRS. O MINS.	HRS. 0 MINS. 1	O MINS.	HRS. O MINS.	. O MINS.	HRS. O MINS.	O MINS.	HRS. O MINS.	O MINS.	HRS.	AMDUNT OF VIOLATION - 0.0	V10L 20 27 27			0.0	AINTS
TOTAL . HAS CONSTRAINT	NIN C	113 S. 48 MIN.	24 MIN.	HAN. 7 AND	2.6 mid.	HRS. G MIN.	HKS. 26 MIN.	HRS. 6 MIN.	HRS. 40 MIN.	HRS. 12 MIN.	HRS. 36 MIN.	O MIN.	HRS. O MIN.	10 MIN.	HRS. 8 MIN.	HRS. 36 MIN.	HRS. O MIN.	16 MIN.	HRS.	WAS CONSTRAINT VIOLATED? NO AMOU	CONSTRAINT VIOLATED? YES YES YES 5 HRS. NO 0 HRS.	0		CONSTRAINT VIOLATED? NO AMOUNT OF VIOLATION	CONSTRAINTS
ICTAL TELEGATION - ECS_IMESE_ITEMS # OF PARAMETERS ITEM IS USED FOR	C. M. M. C.			AUTOMATIC EURET	TER	ALAL BALANCE	9 OVE4 (105 C)	0VEN (180 C)	DESSICATOR	TECHNICON	CARRON ANALYZER		VACUUM SOURCE	8 MAGNETIC STIRRER		TECH AUTGANALYZERZ	CAS CHROM WI FID		28 HUTPLATE 1	IDIAL_YAN_SPACE TOTAL VAN SPACE ALLOCATED = 93.000 GBAND_IDIAL_ANALYSIS_IIME	1 28 HRS. 2) 2 19 HRS. 27 3 14 HRS. 27		IGIAL_COSI	TOTAL COST - \$ 0.0 WAS CONSTRAIN	

CORRCT OUTPUT

Figure XXVII

PARAMETERS WERE MEASURED.	0.340000	249.999954	385.175537	2 PARAMETERS WERE MEASURED.	99.707	0.293	ATED 384.077393			321.847900	530.155273	250.000107	249.999969	74.800873	7.646317
AMETERS	0 10	CALCULATED	CALCULATED	METERS W			CALCULATED			SAS	5AS	5AS	5AS	5AS	SAS
3 PARA	MODIFIED TO	CAI	CAI	2 PARA	PERCENT CONTRIBUTION	BUTION				BRANCH	BRANCH	BRANCH	BRANCH	BRANCH	BRANCH
1ERE	00	00	000	HERE D.) IN	ONTRI				FROM	FROM	FROM	FROM	FROM	FROM
BRANCH I WHERE	0.40000	200.000000	370.000000	BRANCH 2 WHERE AS INDICATED.		O.001000 A PERCENT CONTRIBUTION OF	900	5 AS 0.045803	0.090197	ESTIMATED FROM BRANCH	ESTIMATED FROM	ESTIMATED	ESTIMATED	IS ESTIMATED FROM BRANCH	IS ESTIMATED FROM BRANCH
				CH A	0.340000	000	260.000000	5 AS	5 AS	15	15	15	15	15	-5
0 03	1.	(ED	(ED	ED ON	0	.001	260			4	2	4	2	4	2
IS UNIQUELY DETERMINED ON	MODEL	MEASURED 7 TO	MEASURED	IS UNIQUELY DETERMINED ON ALSO CONTRIBUTE TO THIS BRANCH	RATE		RED TED TO	IS ESTIMATED FROM BRANCH	IS ESTIMATED FROM BRANCH	OF SOURCE	OF SOURCE	OF SOURCE	OF SOURCE	OF SOURCE	OF SOURCE
S UNIQUELY	3	OLIDS SOURCE CORRECTED TO		S UNIQUELY CONTRIBU	FLOW RATE	2 IS MODIFIED TO	MEASURED CE CORRECTED	TIMATED F	TIMATED F	ō	ō	0	0	0	ō
-	FLOW	D SOLIDS SOURCE			-		FOLLOW. SOURCE	4 1S ES	5 IS ES	D SOLIDS	D SOLIDS				
SOURCE NUMBER		DISSOLVED SOLIDS	ACIDITY	SOURCE NUMBER OTHER SOURCE(S)	SOURCE NUMBER	FLOW RATE OF SOURCE	OTHER PARAMETERS FOLLOW. ACIDITY SOU	FLOW OF SOURCE	FLOW OF SOURCE	DISSOLVED SOLIDS	DISSOLVED SOLIDS	SULFATES	SULFATES	ACIDITY	ACIDITY

